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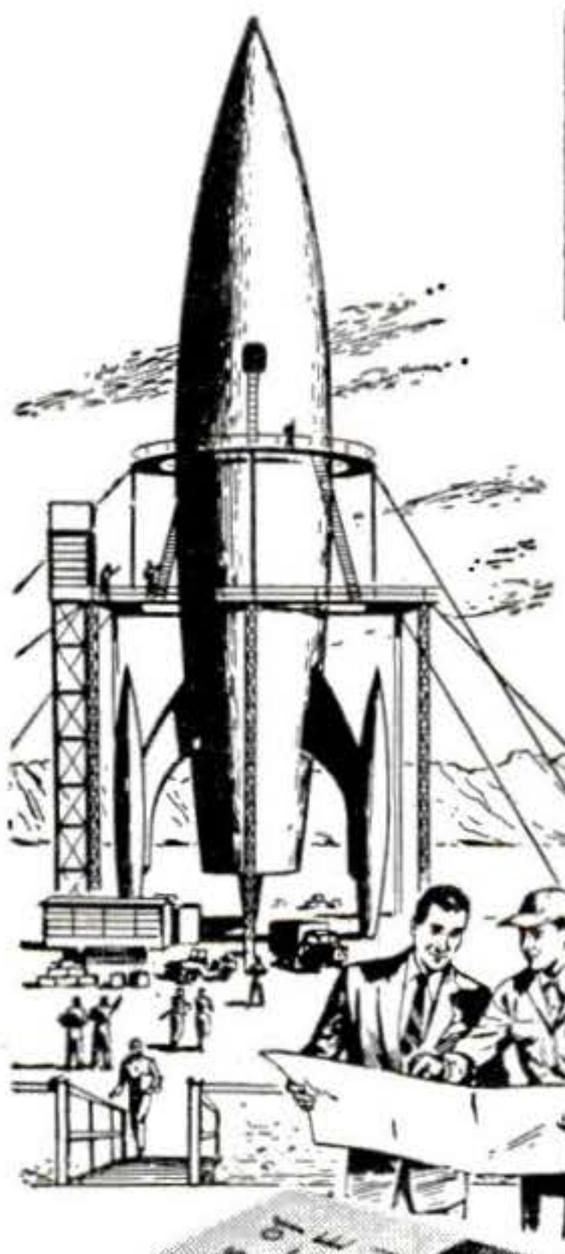

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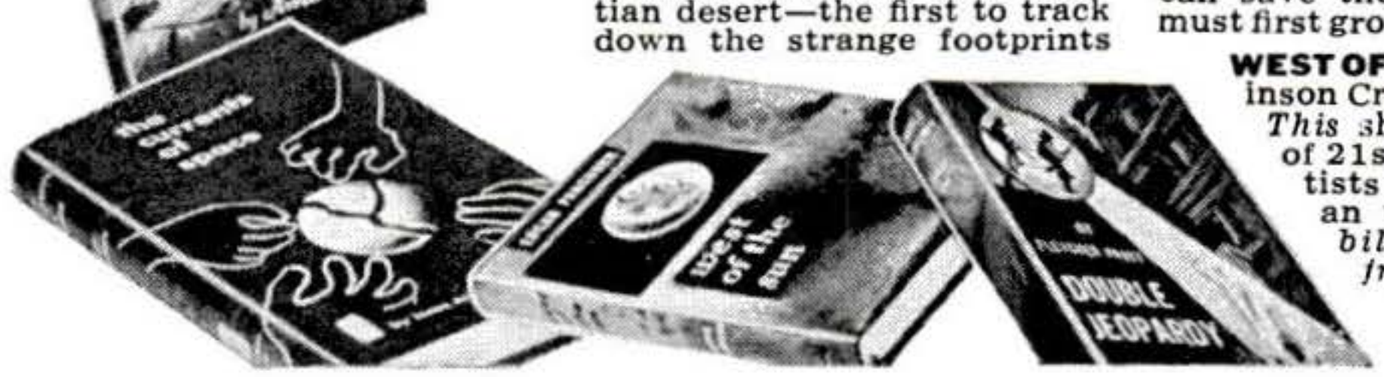

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JUNE, 1953

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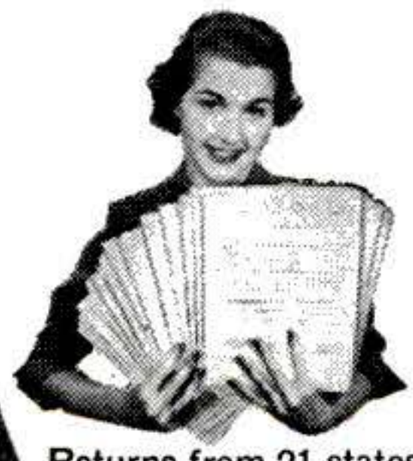

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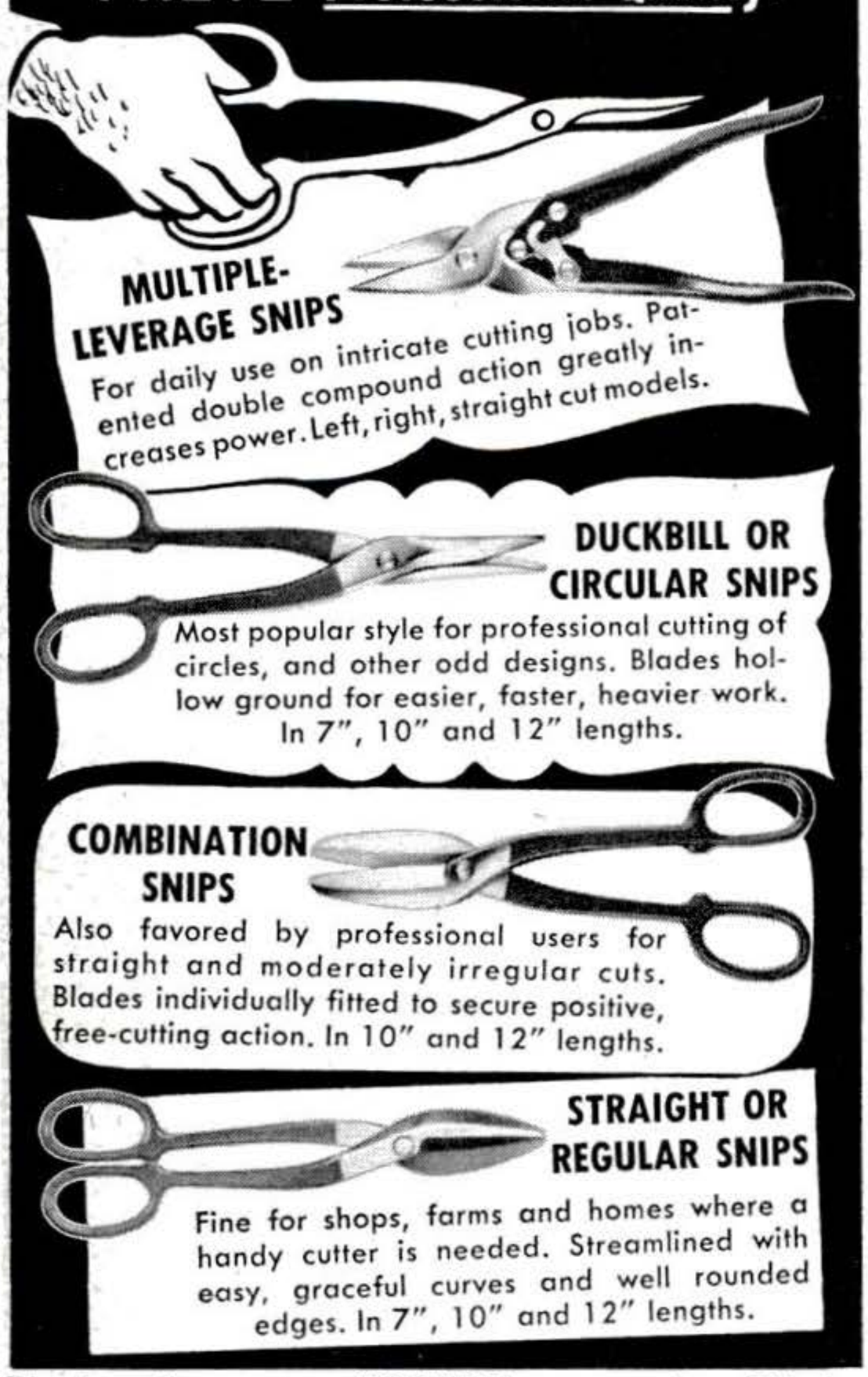

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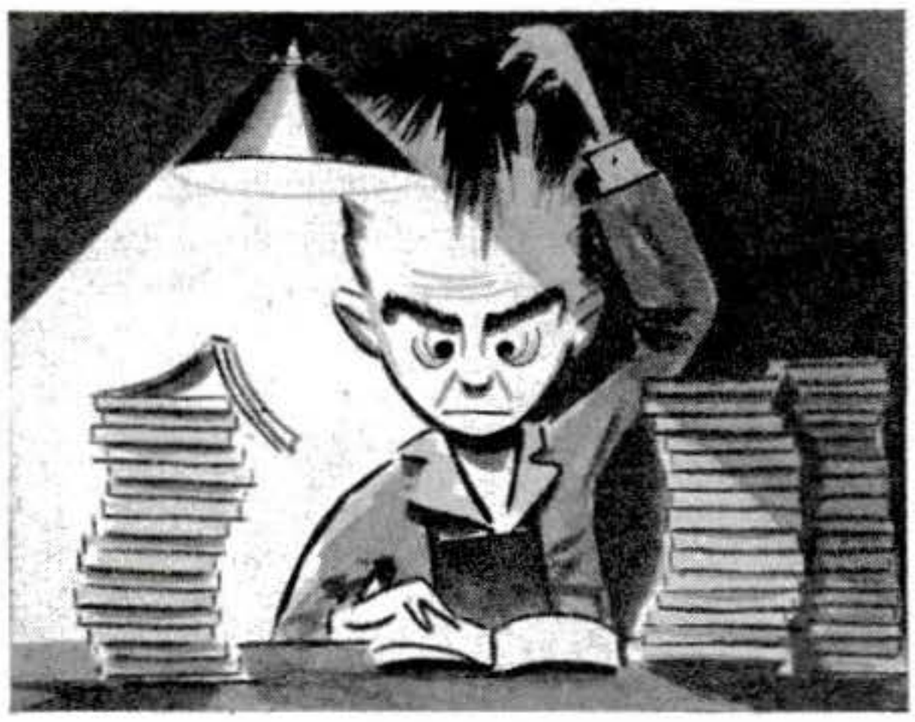

The unhappy fellow above doesn't know that a complete index to PSM's Mechanics and Homebuilding sections for the past year will appear in the July issue. Fully cross-indexed, this guide will help you find hundreds of valuable home-workshop ideas in that file of back copies.

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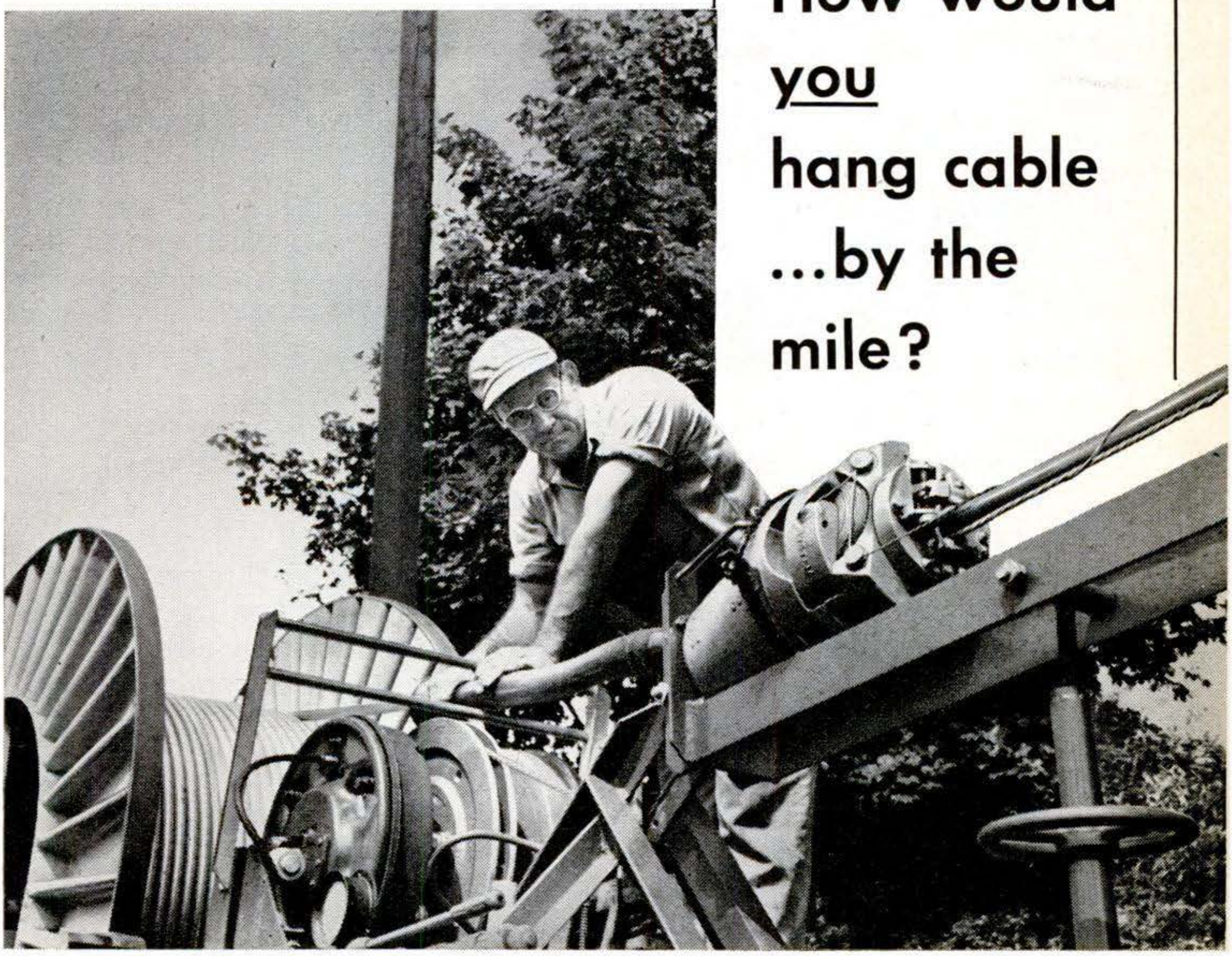
Cable lasher appears to right of workman. As the cable and supporting strand feed through, the machine rotates, binding them together with steel lashing wire. Meanwhile, a winch hauls the lashed cable into position.



How would you hang cable ...by the mile?

It is a job your telephone company faces every day. Thousands of miles of cable go up each year—all secured to steel strand running from pole to pole. The best way to secure cable is to *lash* it to the strand with a spiral binding of wire.

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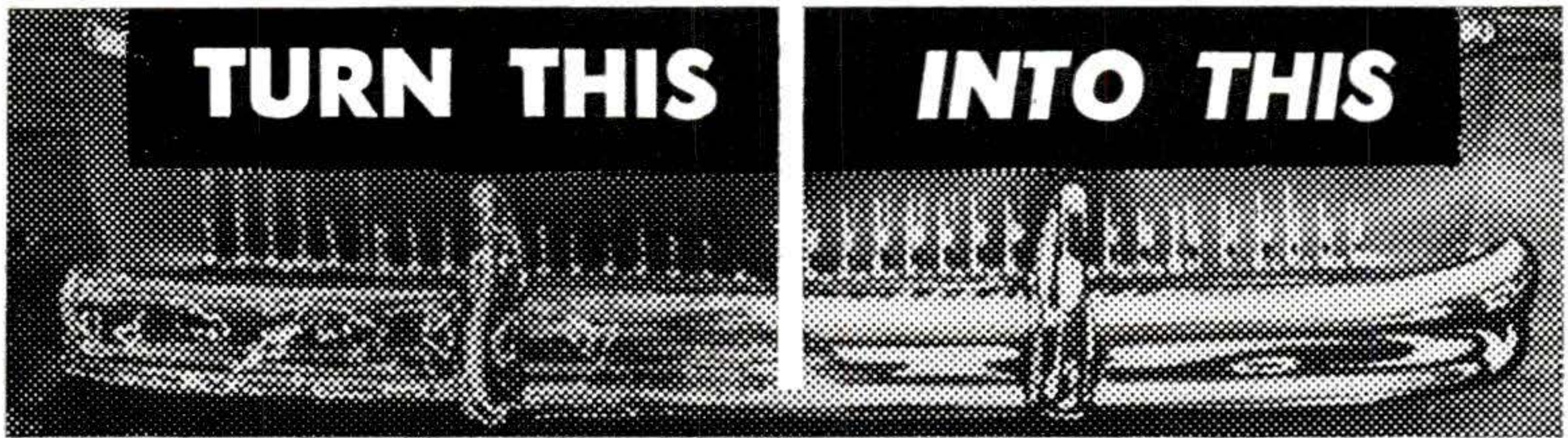

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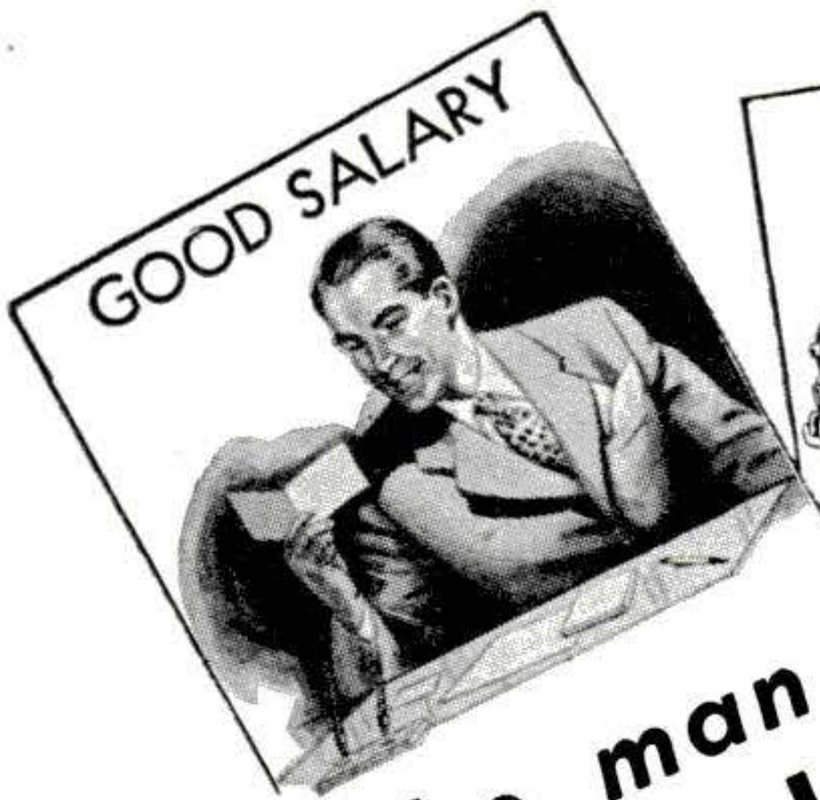

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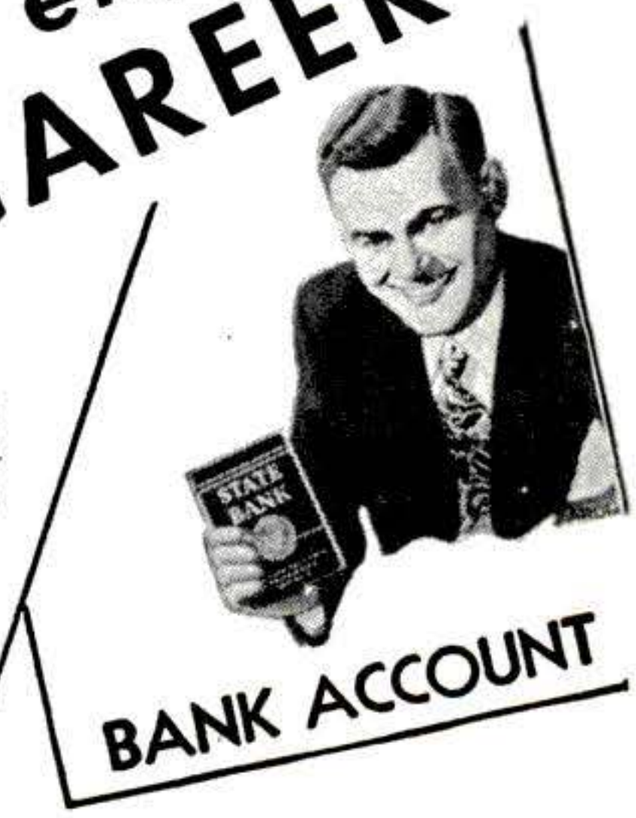

IF you're that man, here's something that will interest you.

Not a magic formula—not a get-rich-quick scheme—but something more substantial, more practical.

Of course, you need something more than just the desire to be an accountant. You've got to pay the price—be willing to study earnestly, thoroughly.

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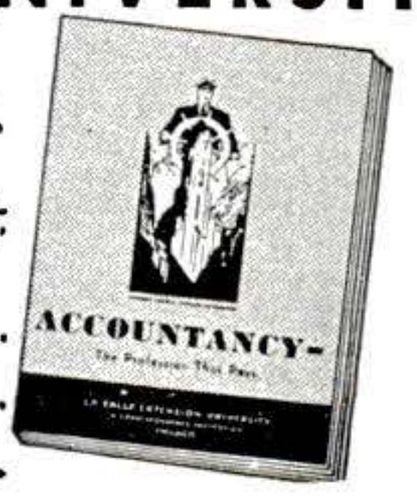
City, Zone & State.....



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You can install a guaranteed

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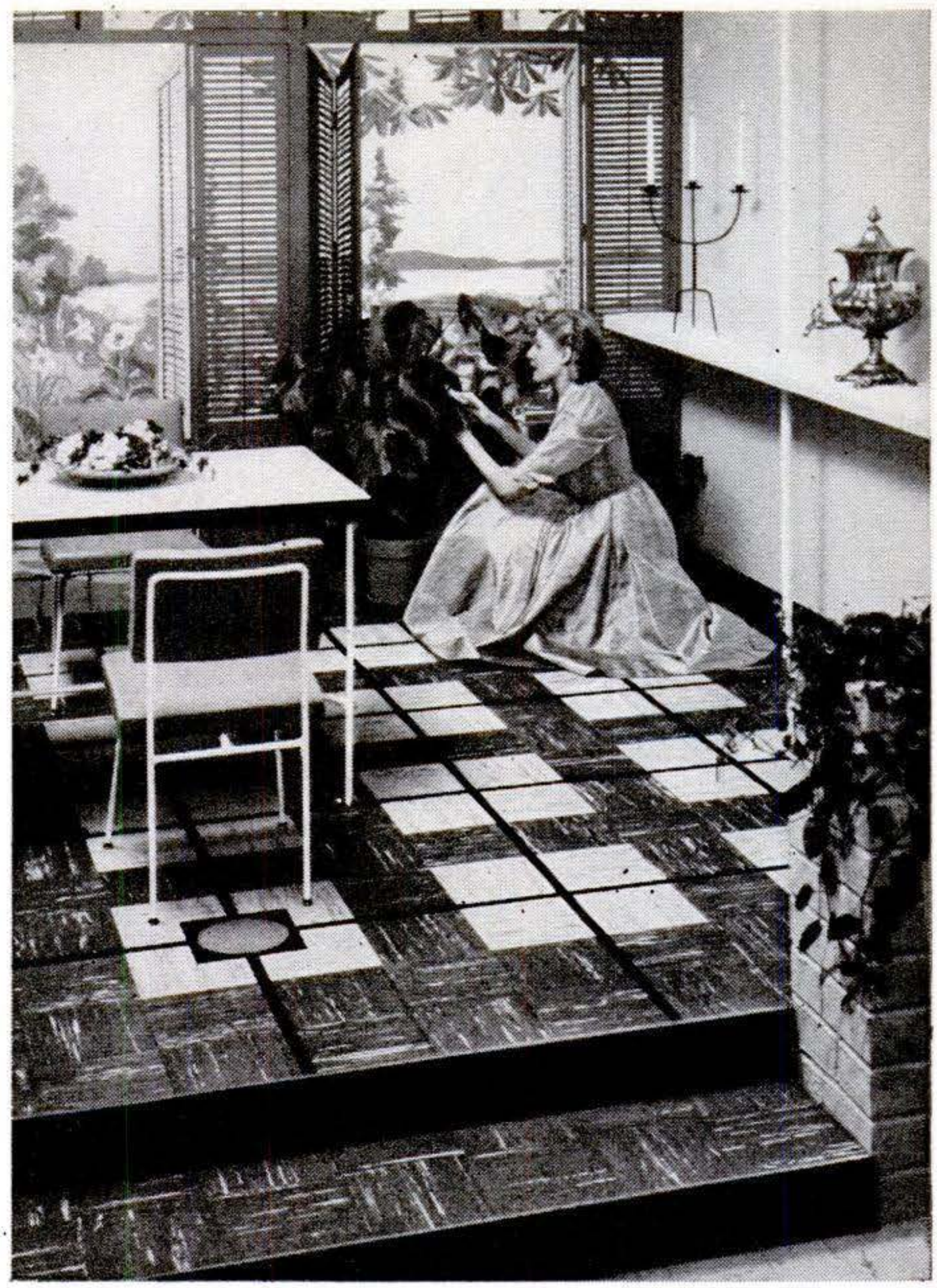
A KENTILE FLOOR LIKE THIS COSTS $9 to $22 LESS THAN TILE FLOORS OF MANY OTHER MATERIALS... YET KENTILE IS GUARANTEED!



You can't imagine how easy it is to install your own Kentile Floor until you've actually done it. Mix or match your choice of the 25 "lovely-to-live-with" colors. Kentile resists soil and stains. And, after parties or just family-fun, Kentile is easy to mop clean.

It's easy to keep glistening like new with an occasional no-rub waxing, too. These modern colors can't get dull or wear off . . . they go clear through the rugged, durable tile. That's why more people buy Kentile . . . because Kentile gives more value.

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GUARANTEE

Kentile, Inc., will furnish new tile without charge for any Kentile that wears out... and on which colors wear off... during your own occupancy of your own home wherein you have installed Kentile or have had it installed by an authorized Kentile Dealer. This guarantee does not apply to damage caused by your improper handling or your failure to follow the instructions for installation and/or maintenance available at your Kentile dealer's. This guarantee must be presented if claim is made for new tile.

*Price quoted is for a floor approximately 11'6" x 9'3" installed by you. Your floor may cost less or slightly more depending on size, colors and freight rates. See your local Kentile, Inc. Dealer for FREE estimate. His name is listed under FLOORS in your Classified Telephone Directory. In Canada, T. Eaton Co., Ltd.

KENTILE, INC., 58 2nd Avenue, Brooklyn 15, N. Y.

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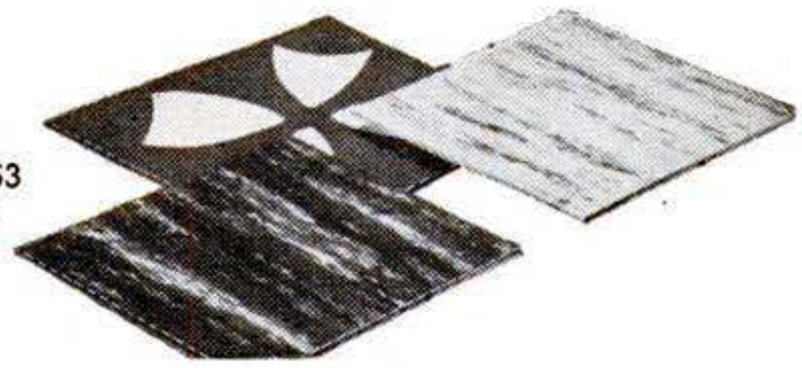

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10 Scarce Stamps—All Different—Sent Free

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MAIL coupon at once. We'll send you this fascinating set of 10 Hitler stamps. Different sizes, colors, values. NO COST TO YOU.

These valuable stamps were issued by the short-lived nation of Bohemia-Moravia. They are much sought after. Now they are becoming SCARCE. And since the nation is no longer in existence—no new issues can be minted. Our supply is limited. So, don't ask for more than one set.

FREE 32-PAGE BOOK

In addition to the FREE Hitler Stamps, we'll also include other interesting offers for your inspection—PLUS a FREE copy of our helpful, informative book, "How To Collect Postage Stamps." It contains fascinating and true stories such as the one about the 1¢ stamp (which a schoolboy gladly sold for $1.50) and which was later bought for FORTY THOUSAND DOLLARS.

This Free Book also contains expert advice on collecting; shows how to get started; where and how to find rare stamps; how to tell their real value; how to mount them, trade them; how to start a stamp club; exciting stamp games, etc. It has pictures galore! Full pages of pictures showing odd stamps depicting native men and women from faraway lands; ferocious beasts, etc.

MAIL COUPON NOW

Be the first in your neighborhood to have this valuable set of Hitler Stamps. Your friends will envy you for it and want to buy the set from you. It will become one of the most prized sets of any stamp collection. But you must hurry if you want to get the 10 Hitler Stamps FREE. This special offer may have to be withdrawn soon. If coupon has already been used, write direct to: **Littleton Stamp Co., Dept. 6-PS, Littleton, New Hampshire. (Enclose 10c to help cover postage and handling).**

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Mail Coupon At Once!

LITTLETON STAMP CO.,
DEPT. 6-PS, LITTLETON, N. H.

Send—AT NO COST TO ME—the valuable set of 10 Hitler stamps and the informative booklet, "How To Collect Postage Stamps." I enclose 10¢ to help cover postage and handling.

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How HATLESS MEN keep hair neat all day long!

- **New-formula grooming aid gives hair *naturally*-neater look without gooey grease or cream!**
- **Removes flaky dandruff . . . makes scalp feel better, more refreshed!**

Whether you go hatless or not, keep hair neatly groomed *all* day the way so many outdoor men do—with Fitch Ideal!

See the neatest trick of all—as Ideal's secret grooming agent . . . *not* a grease, oil nor cream . . . makes thin hair look thicker —thick hair *stay* slicker!

Ideal *also* relieves dry, itchy scalp—*also* removes loose dandruff—*while* it works its grooming miracles!

Feel its new tonic action. Feel your scalp tingle with invigorating freshness! Note—there's *no* lingering, tell-tale odor!

Start tomorrow. Just seconds—massaging hair and scalp with a dash of new Fitch Ideal—will pay off *all* day! You can count on Fitch Ideal for that smart, *naturally*-neater look of the man who's going places! At all drug counters—also ask Barbers for professional applications.

Get new

FITCH *Ideal* HAIR TONIC

Letters

One Vote for Science

I know it is impossible to please all the public all of the time, and even very hard to please some of the public some of the time; but let's not forget that word *science* in the title of your magazine.

DOUGLAS THOMAS, Alamosa, Colo.

Please try this month's article on the H-bomb (p. 96).

Here's a T for You

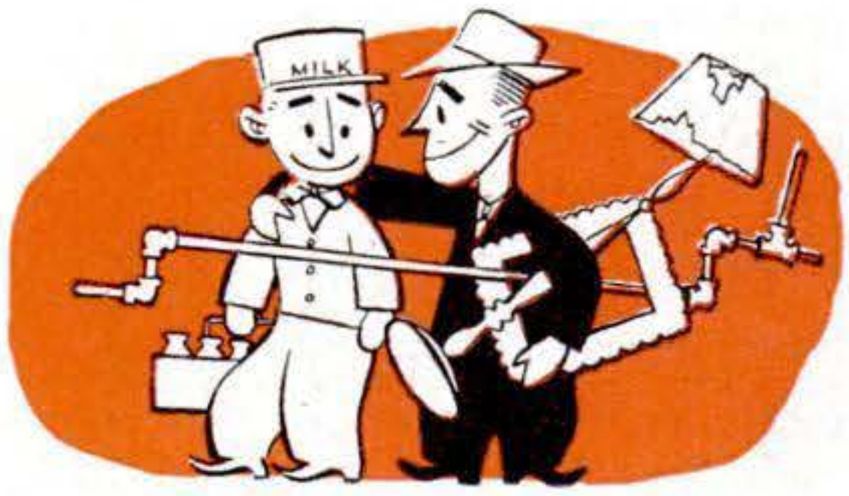
I would like to inform all concerned that there is a Ford Model T roadster in a field with other farm scrap about two miles north of Batesville, Ind., on the left side of the New York Central Railroad tracks, condition unknown, as I just noticed it from a fast train.

If this information eases someone's pain, I smoke cigars and think the tip would be worth a box of same.

GUY M. TAYLOR, Newport News, Va.

How to Find Hard-to-Find Items

A handy man or craftsman at one time or another needs some item that is hard to find. I've located many hard-to-find articles



just by knowing the right people—the electric-meter reader, the water-meter reader, plumber, electrician, fuel-oil delivery man, insurance collector, milkman. Basically the people to see are the ones whose jobs take them into people's homes, cellars, garages, attics, barns, etc., where hard-to-find items may be stored and forgotten about. Once

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I WILL TRAIN YOU AT HOME FOR GOOD PAY JOBS IN RADIO-TELEVISION

J. E. SMITH has trained more men for Radio-Television than any other man.

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America's Fast Growing Industry Offers You

I TRAINED THESE MEN

LOST JOB, NOW HAS OWN SHOP
"Got laid off my machine shop job which I believe was best thing ever happened as I opened a full time Radio Shop. Business is picking up every week."—E. T. Slate, Corsicana, Texas.

GOOD JOB WITH STATION
"I am Broadcast Engineer at WLPM. Another technician and I have opened a Radio-TV service shop in our spare time. Big TV sales here . . . more work than we can handle."—J. H Bangley, Suffolk, Va.

$10 TO $15 WEEK SPARE TIME
"Four months after enrolling for NRI course, was able to service Radios . . . averaged $10 to $15 a week spare time. Now have full time Radio and Television business."—William Weyde, Brooklyn, New York.

AVAILABLE TO **VETERANS** UNDER G.I. BILLS

WANT YOUR OWN BUSINESS?
Let me show you how you can be your own boss. Many NRI trained men start their own business with capital earned in spare time. Robert Dohmen, New Prague, Minn., whose store is shown at left, says, "Am now tied in with two Television outfits and do warranty work for dealers. Often fall back to NRI textbooks for information."

1. EXTRA MONEY IN SPARE TIME

Many students make $5, $10 a week and more EXTRA fixing neighbors' Radios in spare time while learning. The day you enroll I start sending you SPECIAL BOOKLETS that show you how. Tester you build with kits I send helps you make extra money servicing sets, gives practical experience on circuits common to Radio and Television. All equipment is yours to keep.

2. GOOD PAY JOB

NRI Courses lead to these and many other jobs: Radio and TV service, P.A., Auto Radio, Lab, Factory, and Electronic Controls Technicians, Radio and TV Broadcasting, Police, Ship and Airways Operators and Technicians. Opportunities are increasing. The United States has over 105 million Radios—over 2,900 Broadcasting Stations—more expansion is on the way.

3. BRIGHT FUTURE

Think of the opportunities in Television. Over 15,000,000 TV sets are now in use; 108 TV stations are operating and 1800 new TV stations have been authorized . . . many of them expected to be in operation in 1953. This means more jobs—good pay jobs with bright futures. More operators, installation service technicians will be needed. Now is the time to get ready for a successful future in TV! Find out what Radio and TV offer you.

You Learn Servicing or Communications by Practicing With Kits I Send

Television Is Today's Good Job Maker

TV now reaches from coast-to-coast. Qualify for a good job as a service technician or operator. My course includes many lessons on TV. You get practical experience . . . work on circuits common to both Radio and Television with my kits. Now is the time to get ready for success in Television!

Keep your job while training at home. Hundreds I've trained are successful RADIO-TELEVISION Technicians. Most had no previous experience; many no more than grammar school education. Learn Radio-Television principles from illustrated lessons. You also get PRACTICAL EXPERIENCE. Pictured at left are just a few of the pieces of equipment you build with kits of parts I send. You experiment with, learn circuits common to Radio and Television.

Mail Coupon—find out what RADIO-TELEVISION Can Do for You

Act Now! Send for my FREE DOUBLE OFFER. Coupon entitles you to actual Servicing Lesson; shows how you learn at home. You'll also receive my 64-page book, "How to Be a Success in Radio-Television." Send coupon in envelope or paste on postal. J. E. SMITH, Pres., Dept. 3FB National Radio Institute, Washington 9, D. C. Our 39th Year.

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Mail me Sample Lesson and 64-page Book, FREE. (No salesman will call. Please write plainly.)

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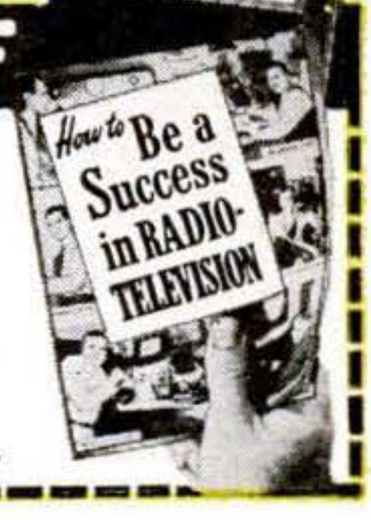

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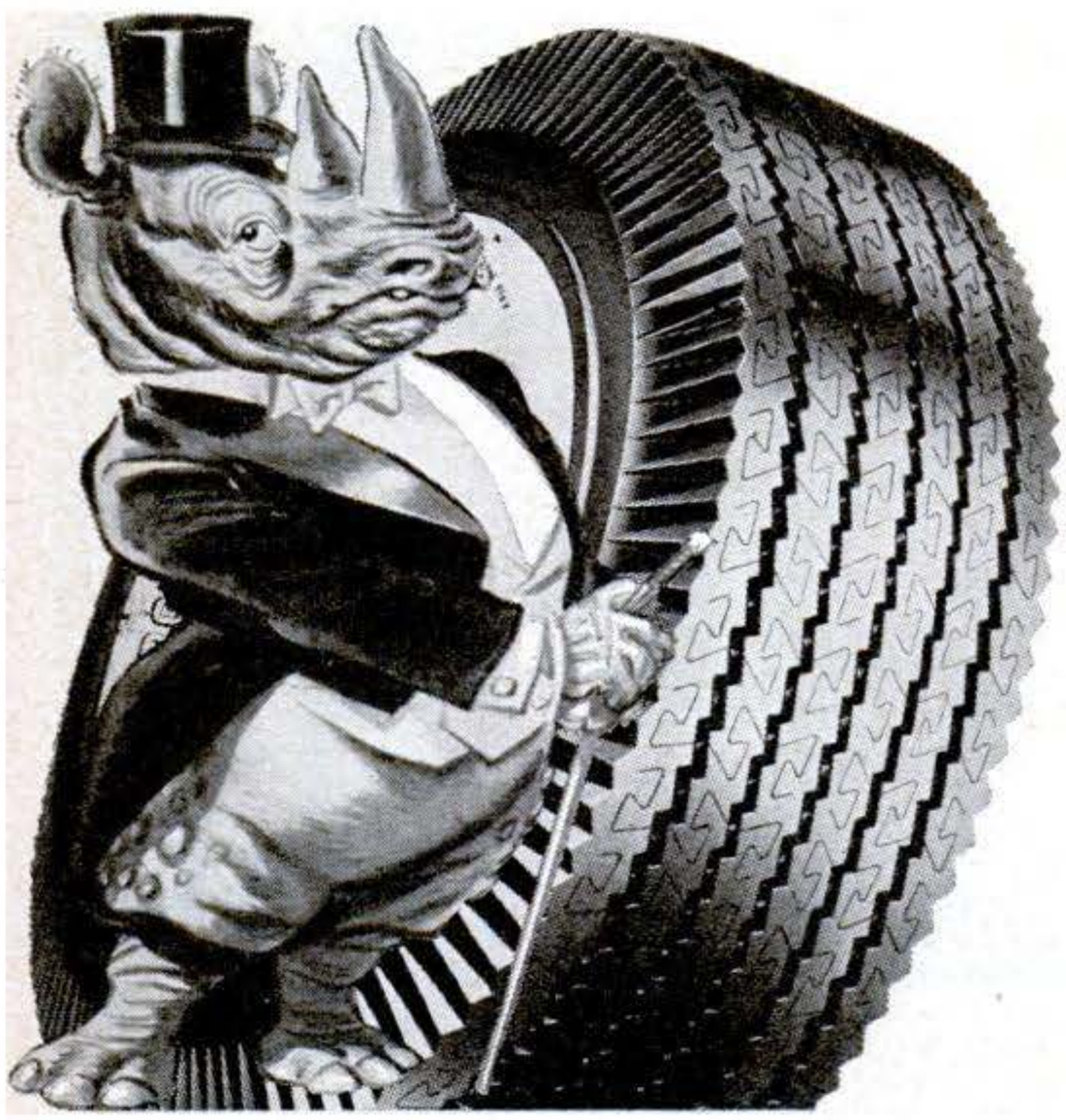

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an item has been located, the rest is easy. It's surprising how willing the owner usually is to be rid of something that's junk to him but a treasure to you.

ARTHUR R. TANNER, Cold Spring, N. Y.

Race-Car Builder Likes Tach

I especially like the fine coverage POPULAR SCIENCE gives automotive topics. As I build and drive dirt-track race cars, I welcomed your electrical tachometer [Dec., p. 174] with open arms. The simplicity of the instrument amazed me, and comparison with a mechanical tach indicates its accuracy.

W. A. COWAN JR., Calgary, Alberta, Canada.

How Old Is New?

As an antique-car collector, I am disappointed that POPULAR SCIENCE MONTHLY

would give space to the restoration of a 1925 Ford. Among collectors this is a "new" car.

B. PAUL MOSER, Los Angeles.

Rear Engines for Safety

Your article "Are Rear-Engine Cars Coming?" [March, p. 116] lists some convincing arguments in favor of putting the engine in back, but it overlooks the most important of all—the part rear-engine location will play in reducing accidents.

The first of the objections you report, for instance, is that "too much weight at rear creates tendency to skid." If it is "too much" at the rear, it is more so over the front wheels, where it makes the car nose-heavy and where it obviously ignores the laws of gravity and centrifugal force.

Other objections listed include:

"Engine ahead of passengers is a safety factor in collision." This is a myth. The engine is bolted down, but the passenger isn't. The only safe collision is the one that doesn't happen. Fewer accidents will happen if the engine is in the rear and the driver is up front where he can see to drive safely and will appreciate the danger of driving too fast.

"Moving the engine back complicates con-

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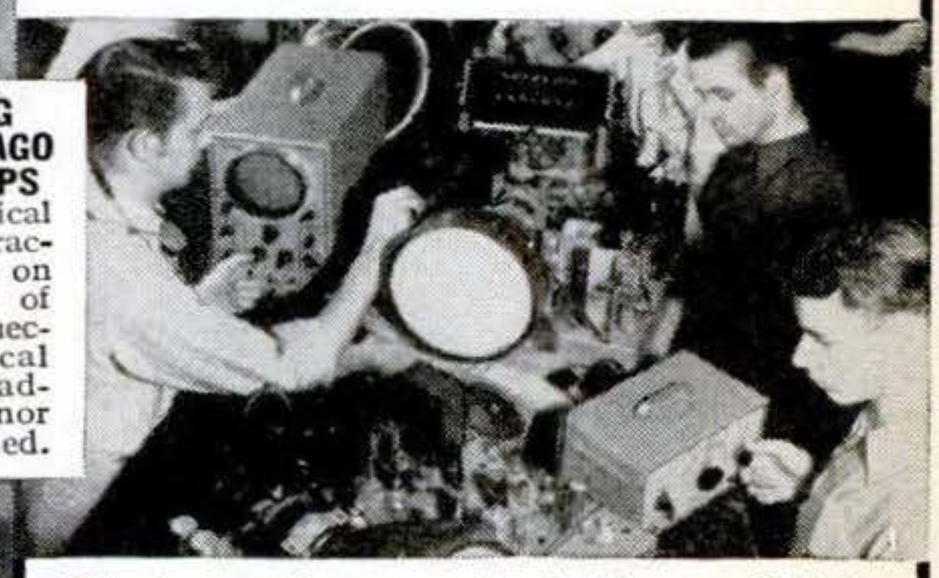

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trols and cooling systems." These have been no real problems to various European cars —the Tatra, Mercedes-Benz, Renault, Volkswagen, etc., over a period of 20 years, nor to American buses that have been in use over the past 15.

"Excessive weight at rear might require dual wheels." Engine weight at present is over the front wheels; it doesn't require dual wheels. Why would it do so if moved to the rear?

As a matter of fact, the engine is in front in today's passenger car because that is where the horse was when autos were first made 60 years ago.

ARTHUR W. STEVENS, President, Automobile Safety Assn., Boston.

Orchids for PSM Writer

You are to be commended for the railroad articles that have been appearing in your magazine. That Henry B. Comstock is a topnotch railroad writer.

GORDON S. HAMILTON, Berea, Ky.

Look-See Mailbox

I notice that one of your readers says he'd like to see them make a clear plastic, rural-

type mailbox so that both the postman and owner could readily see if there was any mail to pick up. Well, I've invented one, and here is a picture of it.

THOMAS O. WRIGHT, Atlanta.

Do It the Easy Way

Another of your readers recently suggested that fuse boxes come equipped with a built-in, battery-powered lamp to eliminate hunting up a flashlight every time a fuse blows.

Why a battery? Just put the lamp on the hot side of the fuse box.

FRED A. COVEY, St. Helena, Calif.

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INVENTORS

Learn how to protect your invention. The U. S. Patent Laws provide that any new and useful art, machine, article of manufacture, or composition of matter, or any new and useful improvement thereof, may be patented if the act of invention is involved. Therefore, every inventor with a valuable invention should take advantage of the Patent Laws and proceed for patent protection in order to safeguard his rights.

A patent gives the inventor the exclusive right to prevent others from making, using, or selling the invention claimed in the patent for a period of seventeen years.

The Patent Laws were enacted for the benefit of the inventor to give him protection for the features of his invention which are patentable. These features must be properly and concisely set forth and claimed in a formal application for patent, in order to comply with the requirements of the Patent Laws. For that reason, unless the inventor is familiar with patent matters, he should engage a competent registered patent attorney or agent to represent him. We are registered to practice before the U. S. Patent Office and are prepared to serve you in the handling of your patent matters.

A specially prepared booklet entitled "Patent Guide for the Inventor", containing detailed information with respect to patent protection and procedure, together with a "Record of Invention" form will be promptly forwarded to you without obligation upon request.

CLARENCE A. O'BRIEN & HARVEY JACOBSON

Registered Patent Attorneys

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You Can Influence Others With Your Thinking

TRY IT SOME TIME. Concentrate intently upon another person seated in a room with you, without his noticing it. Observe him gradually become restless and finally turn and look in your direction. Simple—yet it is a *positive demonstration* that thought generates a mental energy which can be projected from your mind to the consciousness of another. Do you realize how much of your success and happiness in life depend upon your influencing others? Is it not important to you to have others understand your point of view — to be receptive to your proposals?

How many times have you wished there were some way you could impress another favorably — *get across to him or her your ideas?* That thoughts can be transmitted, received, and understood by others is *now* scientifically demonstrable.

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The tales of miraculous accomplishments of mind by the ancients are now known to be fact—not fable. The method whereby these things can be INTENTIONALLY, not accidentally, accomplished has been a secret long cherished by the Rosicrucians—one of the schools of ancient wisdom existing throughout the world. Write for the free copy of the fascinating sealed book, "THE MASTERY OF LIFE," which explains how you may receive this unique wisdom and benefit by its application. Address: Scribe V.C.V.

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INVENTORS

If you believe that you have an invention, you should find out how to protect it. The first step is to have a search made of the prior pertinent U. S. patents. If a report on this search indicates that the invention appears patentable you can apply for a patent, and the specifications and claims should be prepared.

The firm of McMorrow, Berman & Davidson, with offices in Washington, D. C., is qualified to take the necessary steps for you. We can make a preliminary search on your invention, advise you whether we think it can be patented, and prepare your application for patent.

Unless you are fully familiar with the U. S. Patent Laws, we recommend that you engage the services of a Registered Patent Attorney to protect your interests. The patent laws are *your* laws. A patent gives you the right to prevent others from making, using or selling the invention claimed in your patent for a period of 17 years.

Use these patent laws for your protection. Investigate whether your invention can be patented. If you have what you believe to be an invention, we suggest that you have this firm make a search for you.

Send for a copy of our Patent Booklet entitled "How To Protect Your Invention," containing information about patent protection and patent procedure. Along with this we will also send you an "Invention Record" form, for your use in writing down and sketching details of your invention. We will mail them promptly. No obligation. They are yours for the asking.

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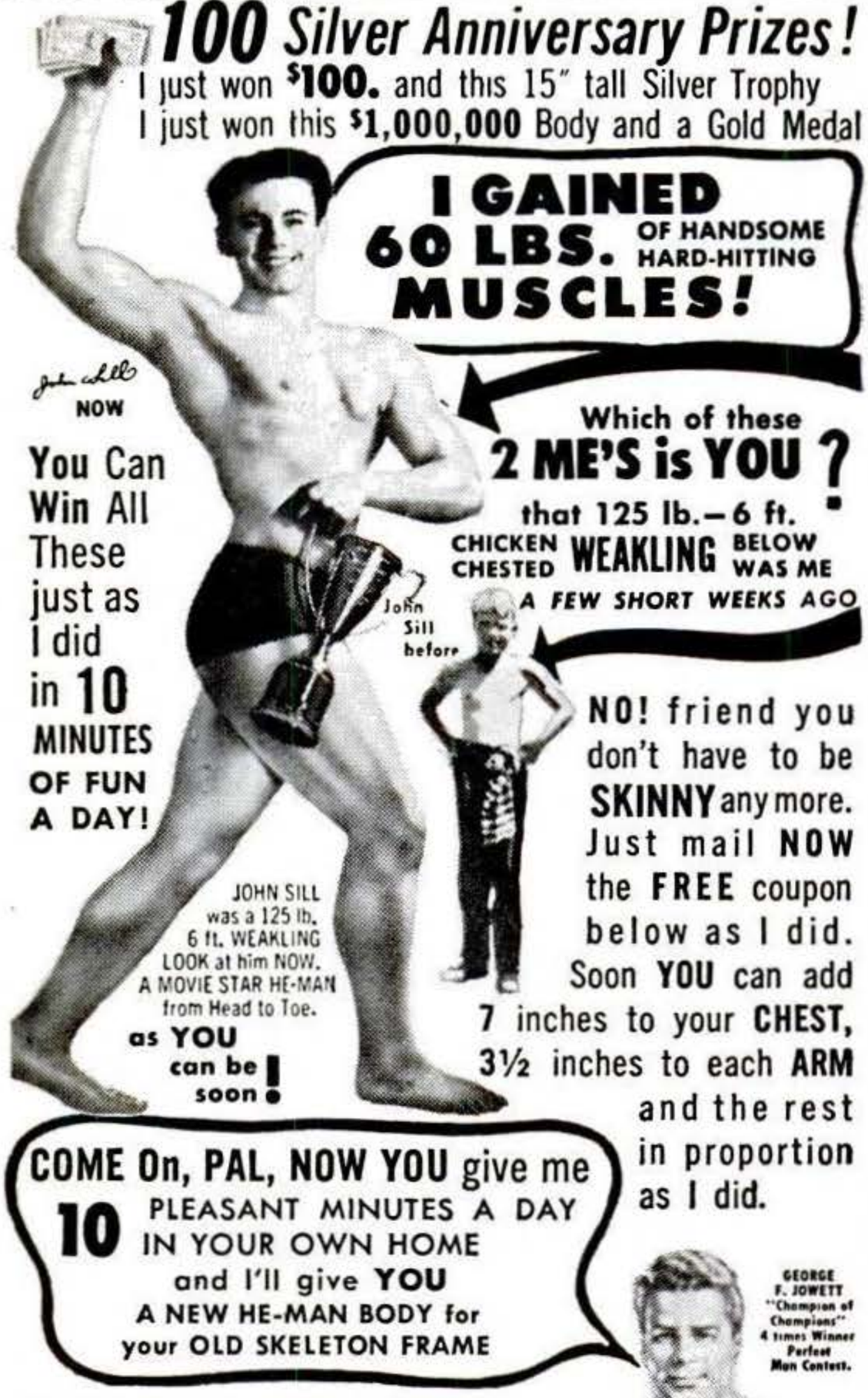

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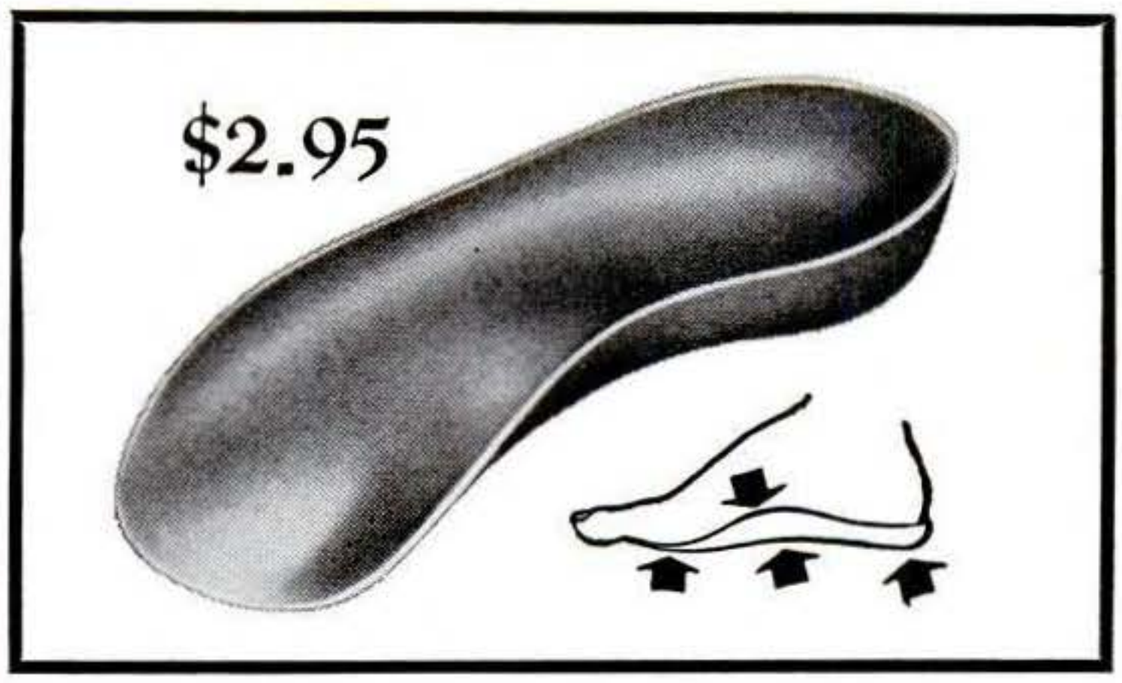

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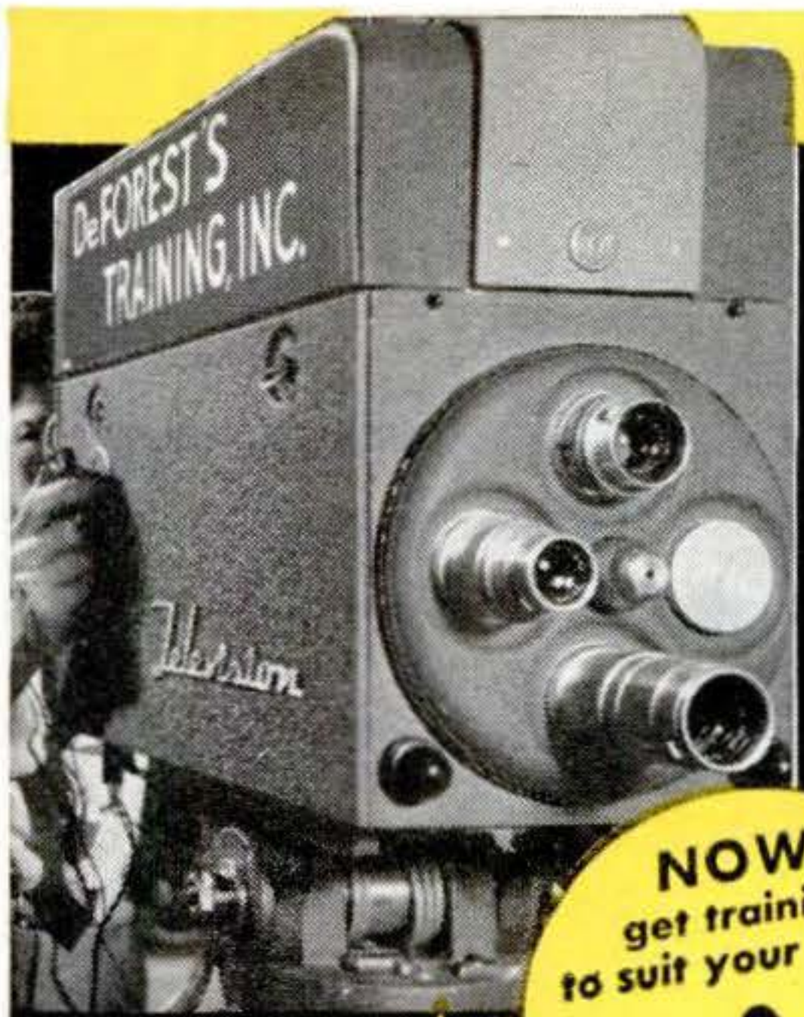

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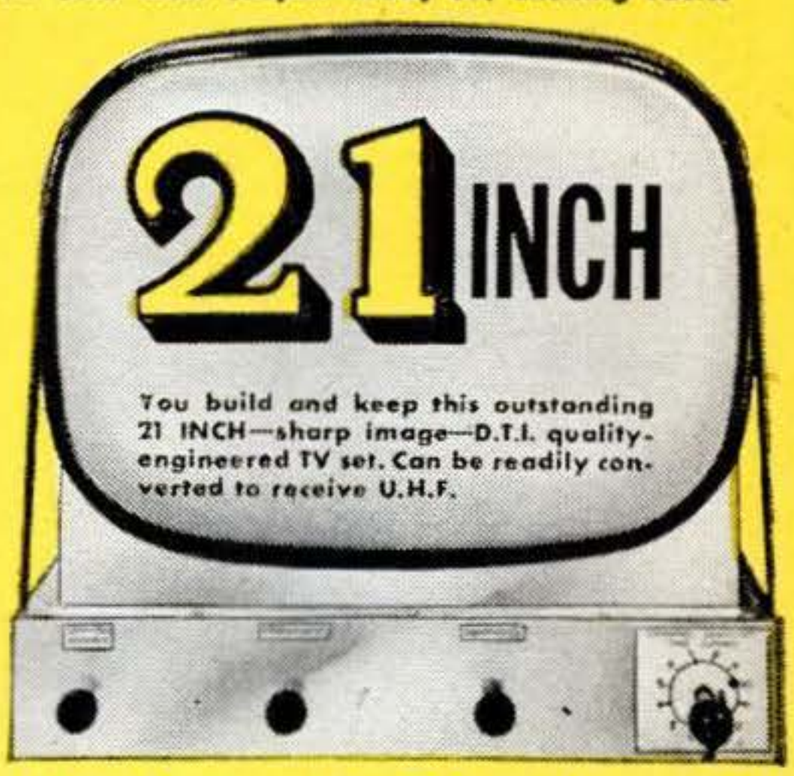

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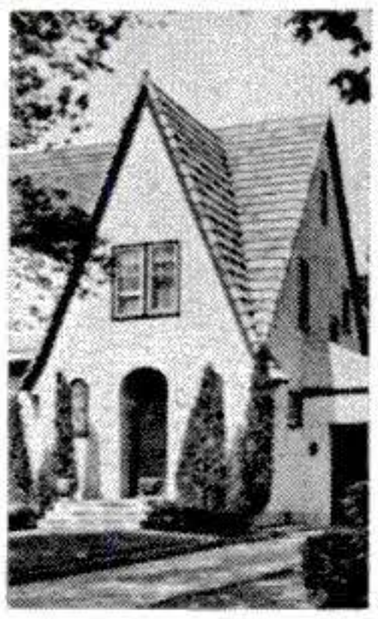

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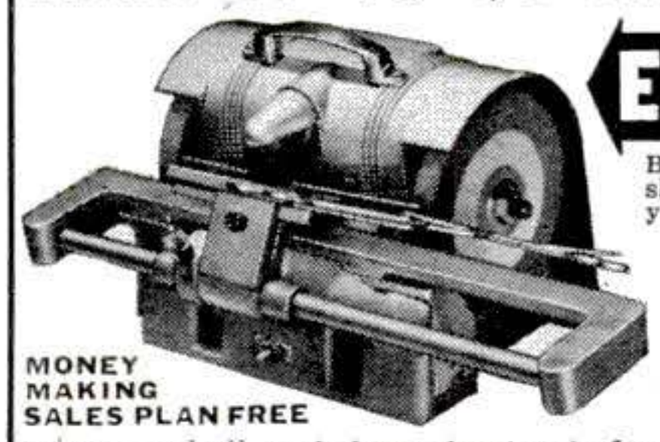

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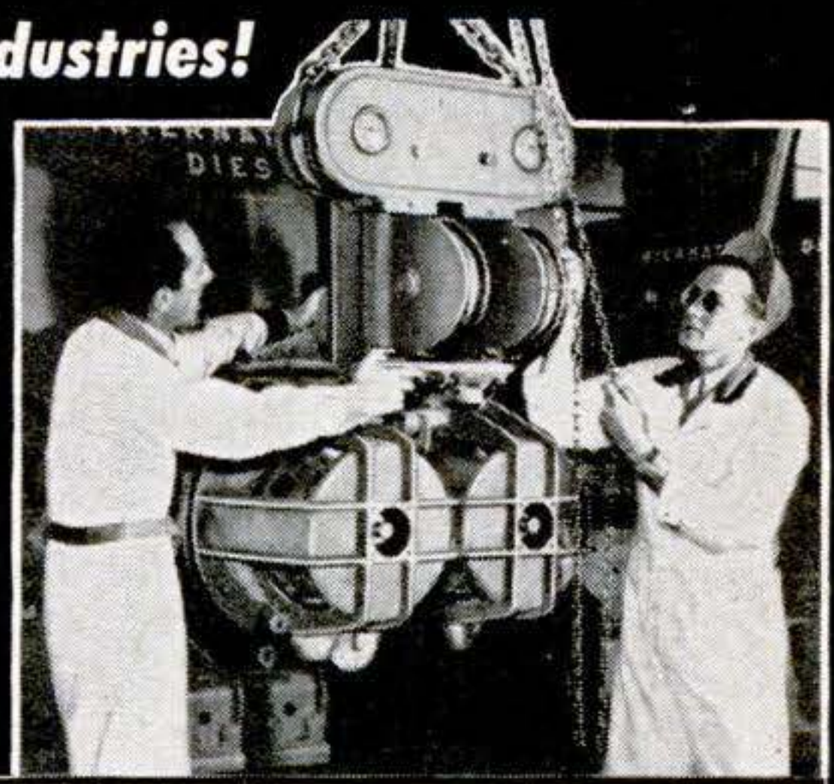

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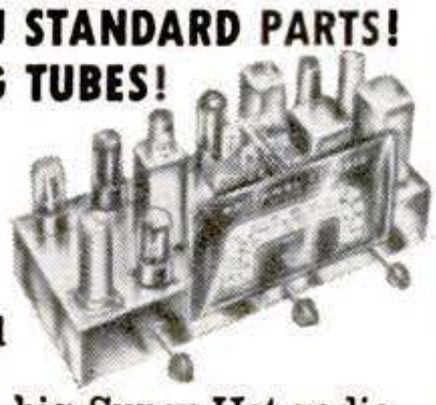

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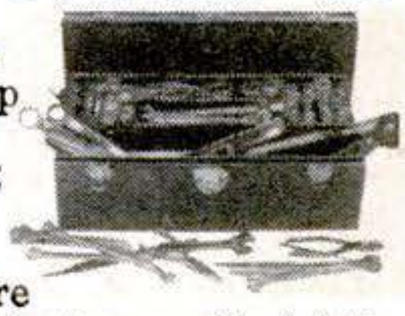

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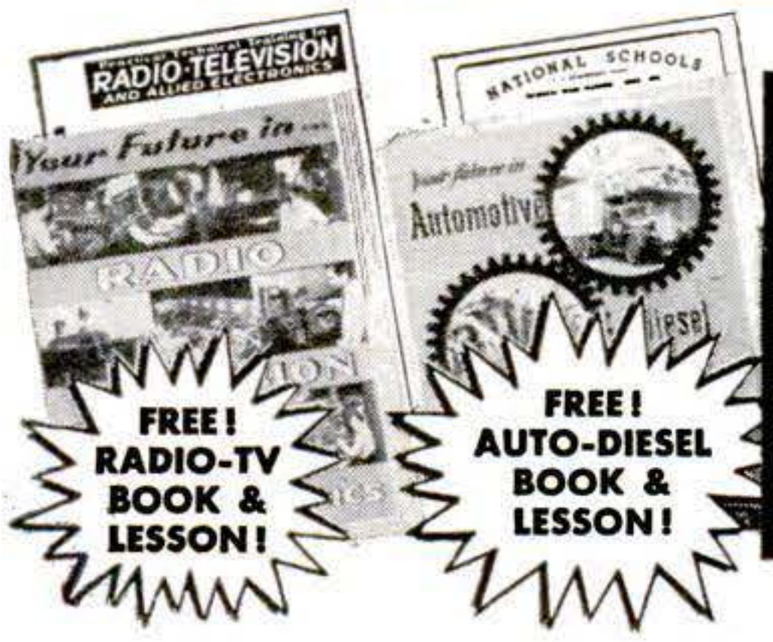

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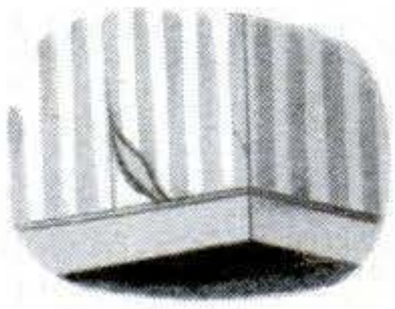

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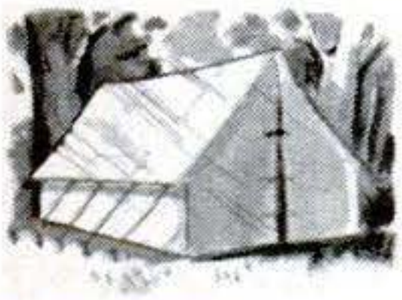

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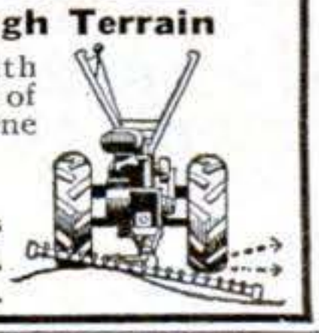

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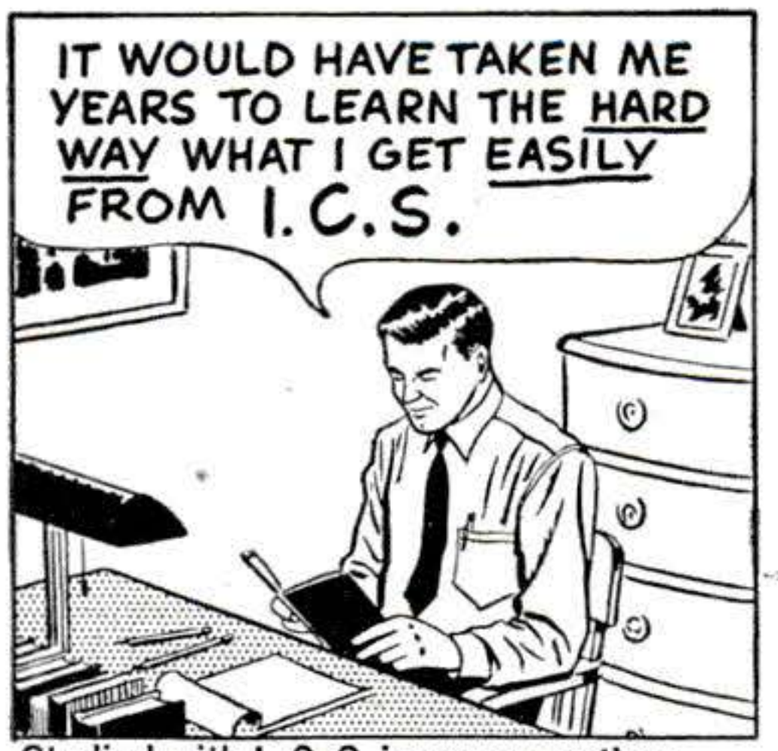

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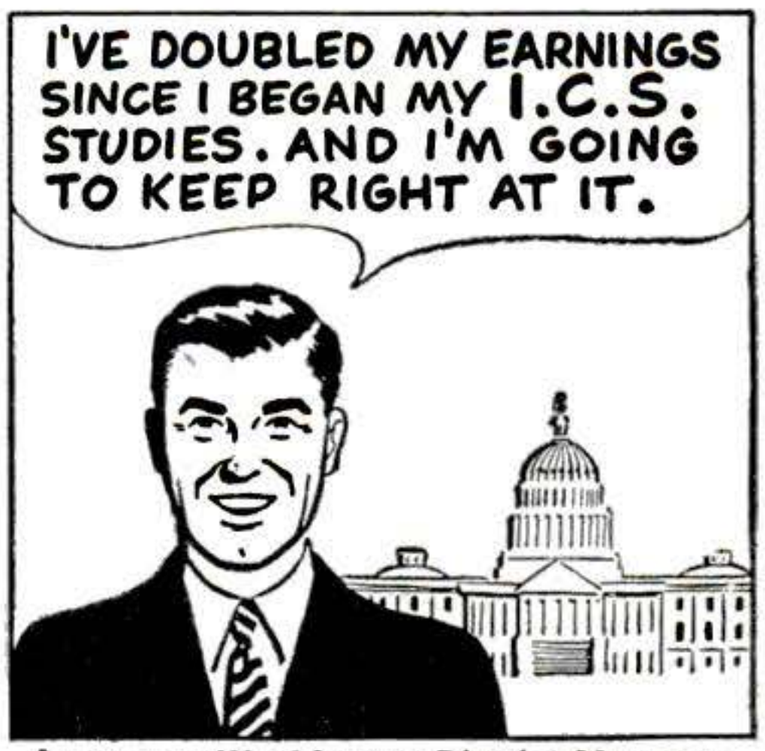

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- ☐ Retail Business Management
- ☐ Managing Small Business
- ☐ Sales Management
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CHEMISTRY
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- ☐ Chemistry
- ☐ Analytical Chemistry
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- ☐ Pulp and Paper Making
- ☐ Plastics

CIVIL, STRUCTURAL ENGINEERING
- ☐ Civil Engineering
- ☐ Structural Engineering
- ☐ Surveying and Mapping
- ☐ Structural Drafting
- ☐ Highway Engineering
- ☐ Reading Blueprints
- ☐ Concrete Construction
- ☐ Sanitary Engineering

DRAFTING
- ☐ Aircraft Drafting
- ☐ Architectural Drafting
- ☐ Electrical Drafting
- ☐ Mechanical Drafting
- ☐ Structural Drafting
- ☐ Sheet Metal Drafting
- ☐ Mine Surveying and Drafting

ELECTRICAL
- ☐ Electrical Engineering
- ☐ Electrician
- ☐ Electrical Maintenance
- ☐ Electrical Drafting
- ☐ Electric Power and Light
- ☐ Lineman

HIGH SCHOOL
- ☐ High School Subjects
- ☐ College Preparatory
- ☐ Mathematics
- ☐ Commercial
- ☐ Good English

MECHANICAL AND SHOP
- ☐ Mechanical Engineering
- ☐ Industrial Engineering
- ☐ Industrial Supervision
- ☐ Foremanship
- ☐ Mechanical Drafting
- ☐ Machine Design-Drafting
- ☐ Machine Shop Practice
- ☐ Tool Design
- ☐ Industrial Instrumentation
- ☐ Machine Shop Inspection
- ☐ Reading Blueprints
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- ☐ Heat Treatment—Metallurgy
- ☐ Sheet Metal Work
- ☐ Sheet Metal Pattern Drafting
- ☐ Refrigeration

POWER
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- ☐ Electric Light and Power
- ☐ Stationary Steam Engineering
- ☐ Stationary Fireman

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- ☐ Radio Servicing—FM
- ☐ Television
- ☐ Electronics
- ☐ Telephone Work

RAILROAD
- ☐ Locomotive Engineer
- ☐ Diesel Locomotive
- ☐ Air Brakes ☐ Car Inspector
- ☐ Railroad Administration

TEXTILE
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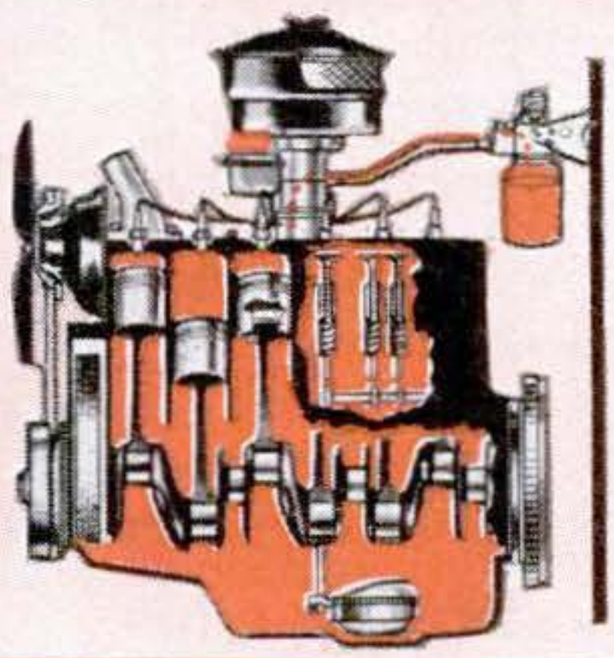

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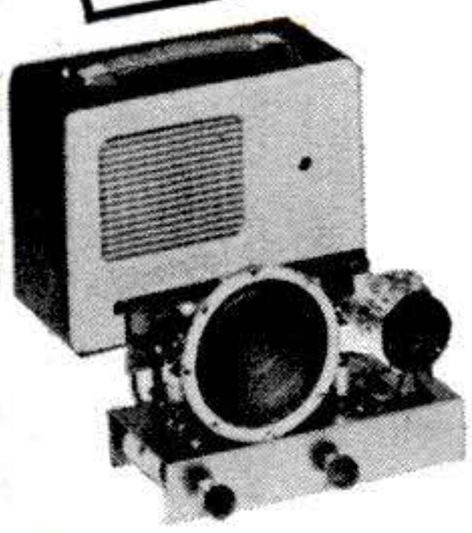

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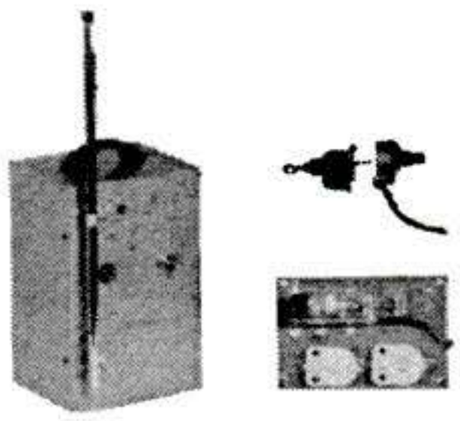

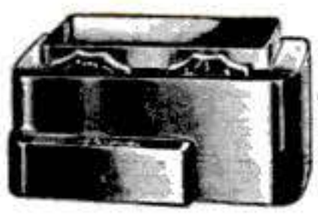

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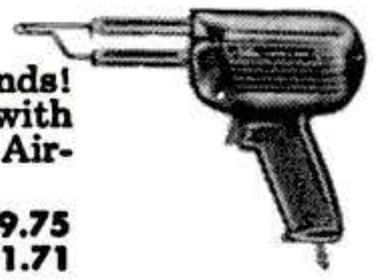

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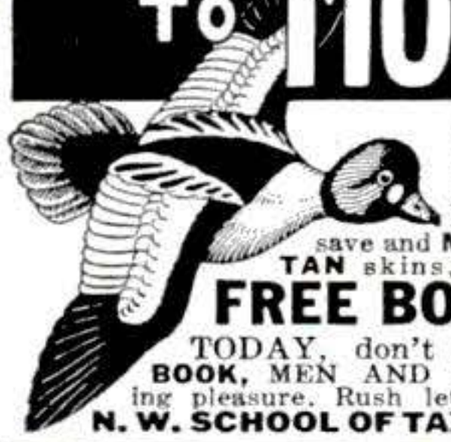

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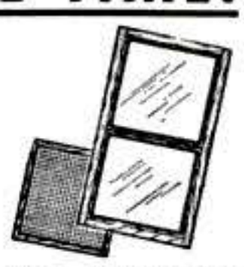

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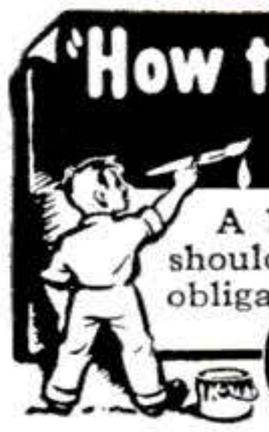

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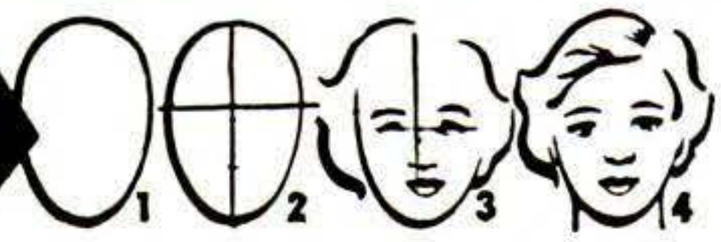

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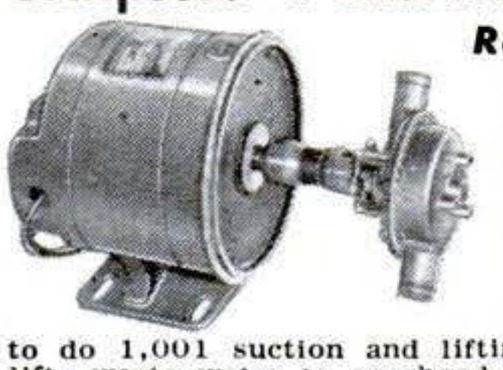

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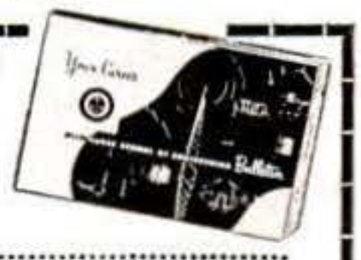

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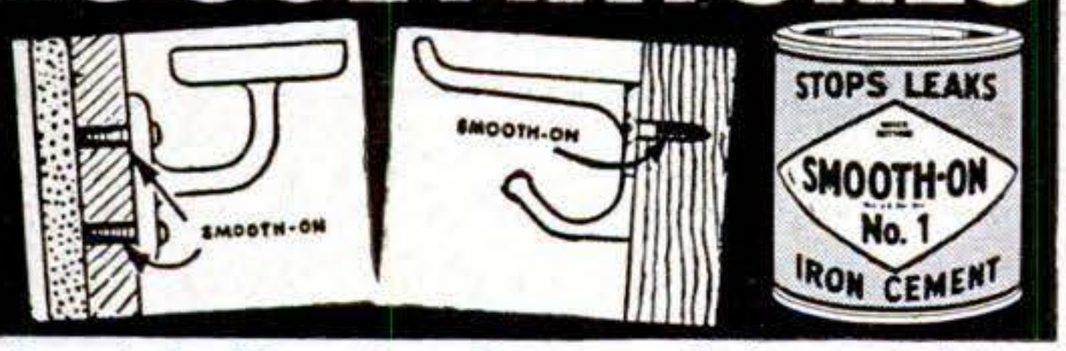

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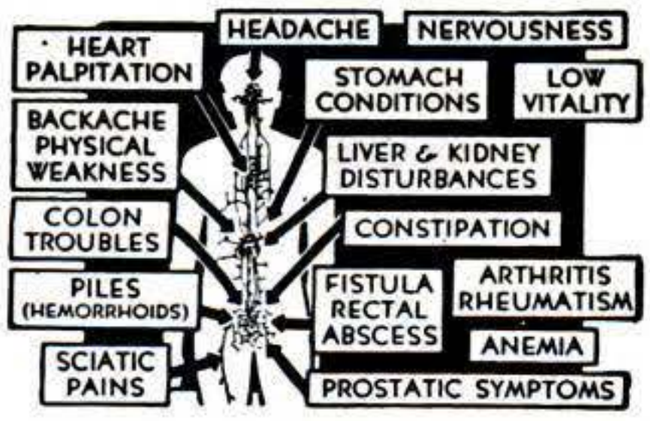

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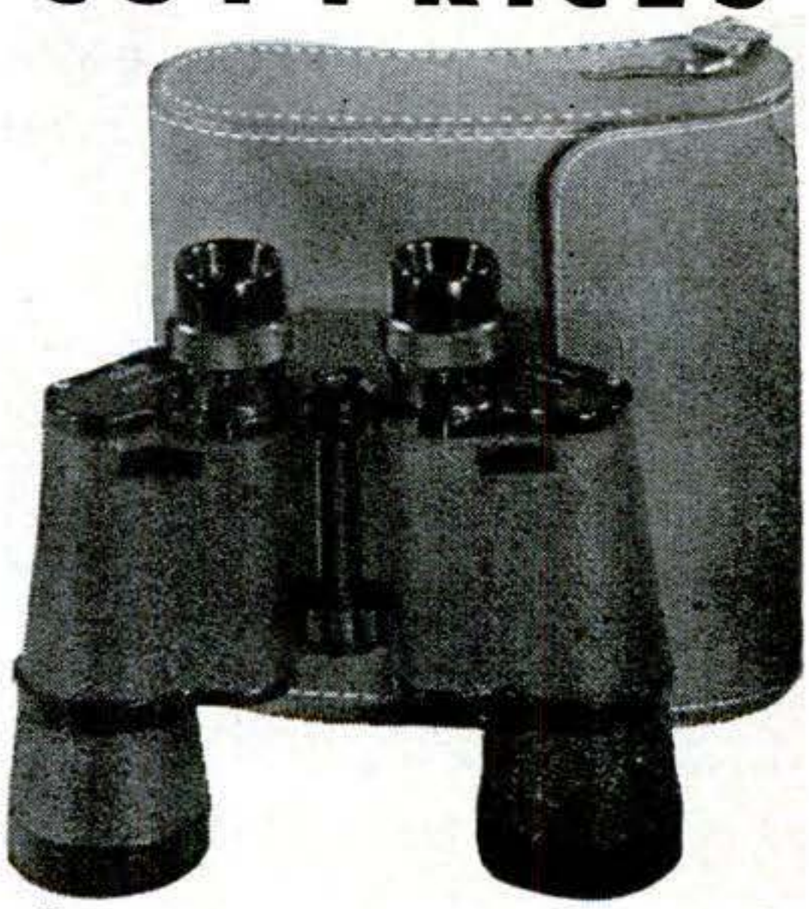

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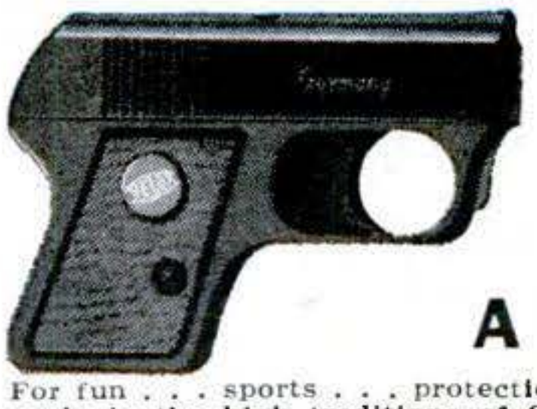

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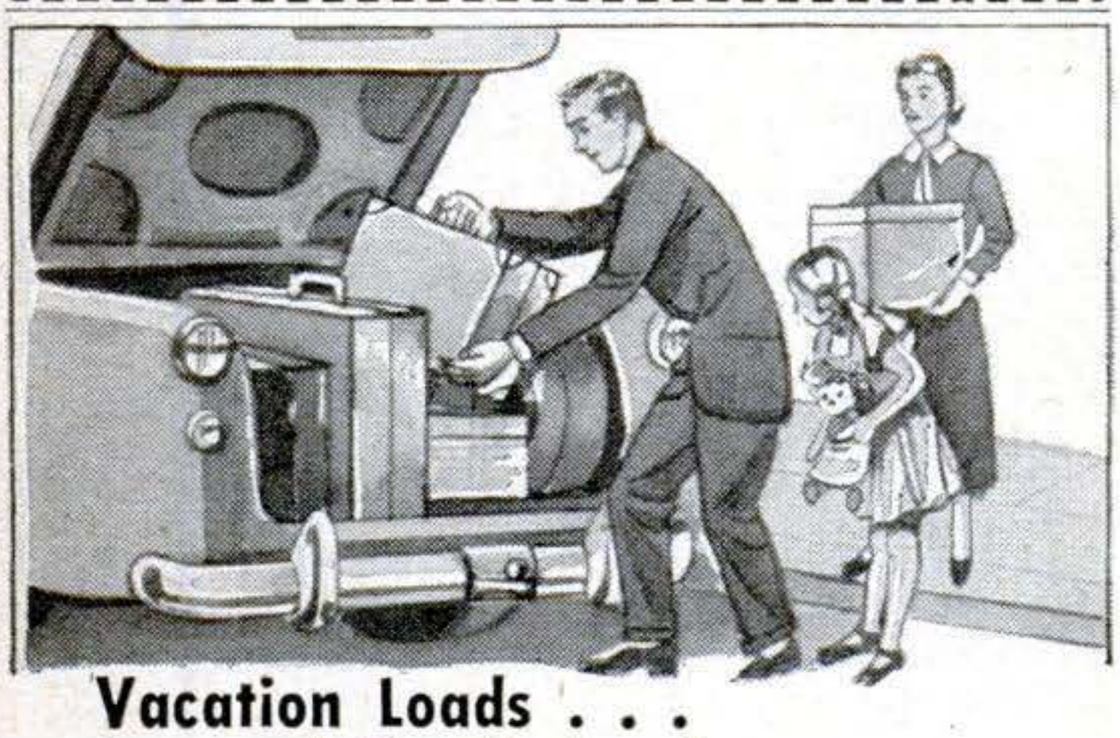

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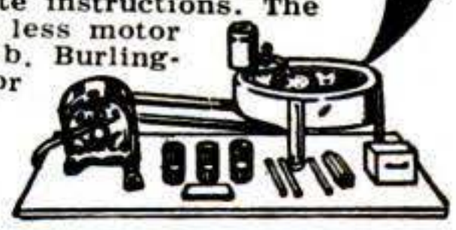

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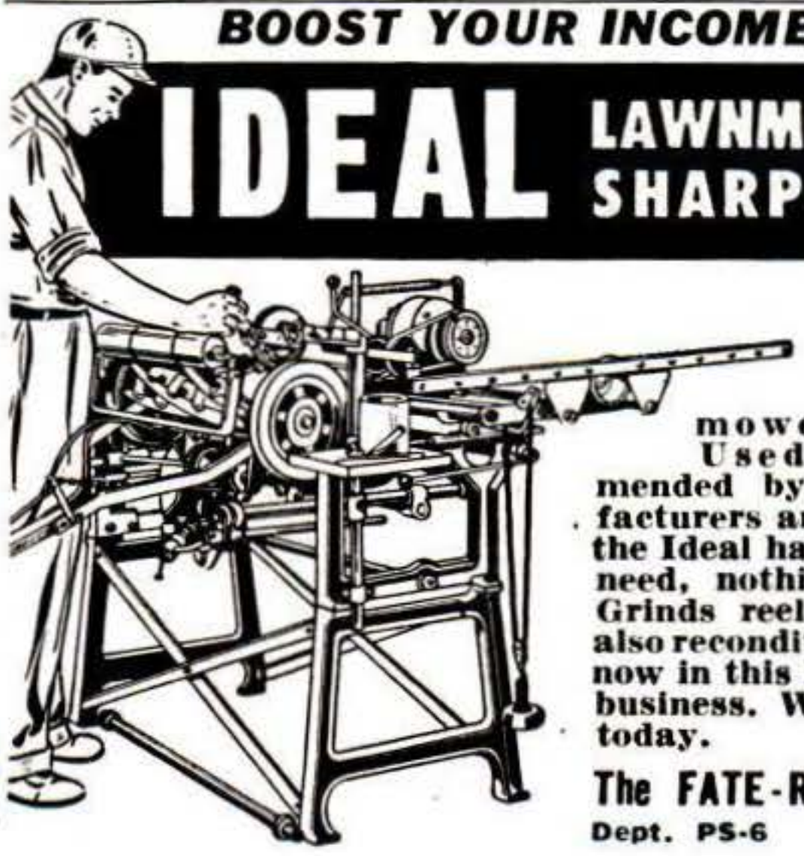

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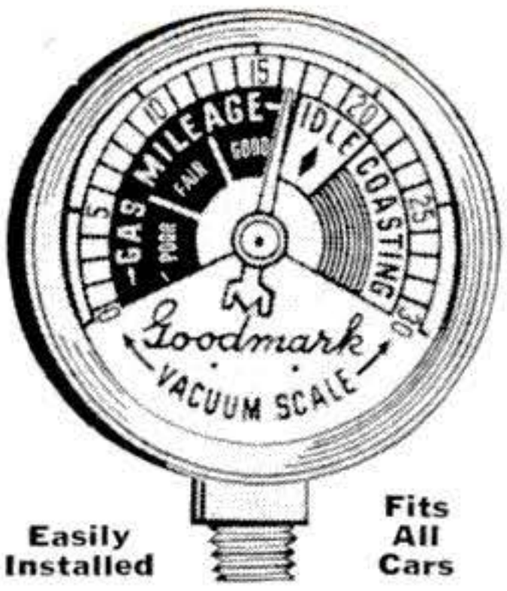

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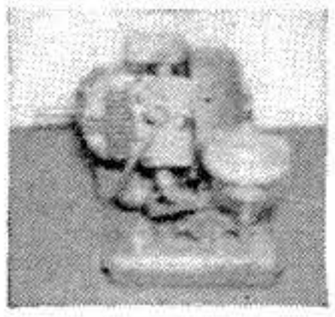

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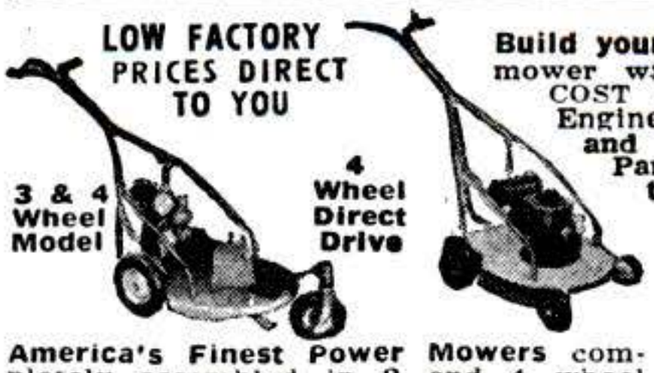

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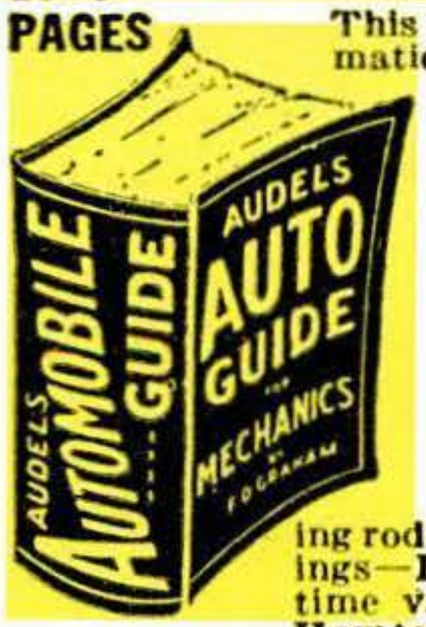

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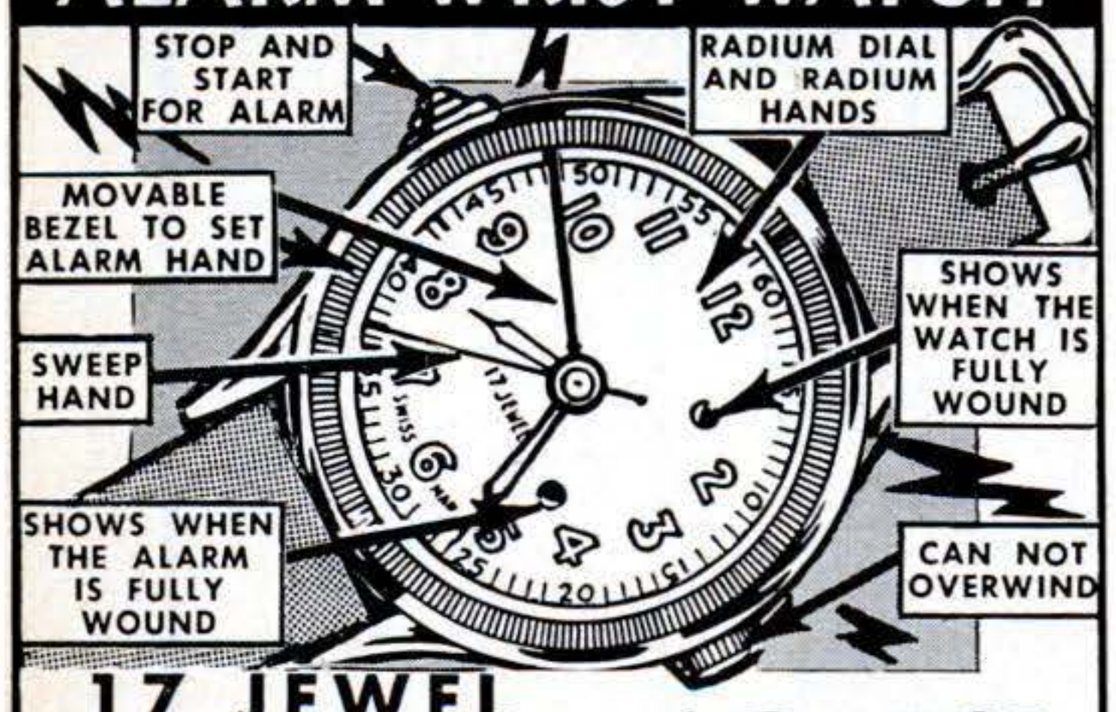

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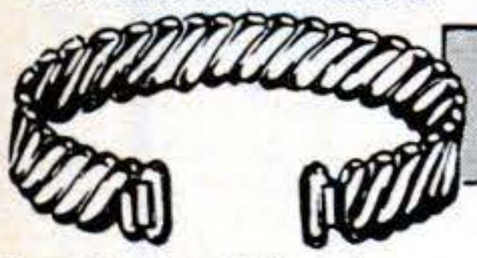

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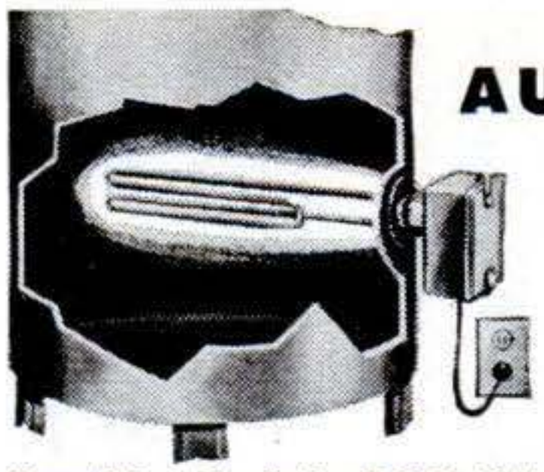

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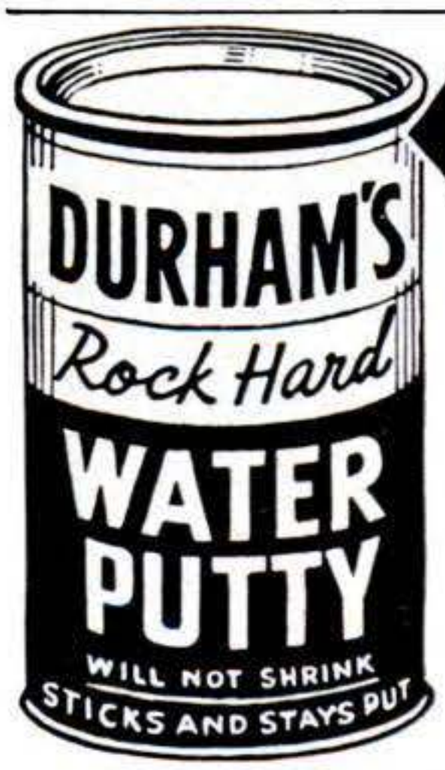

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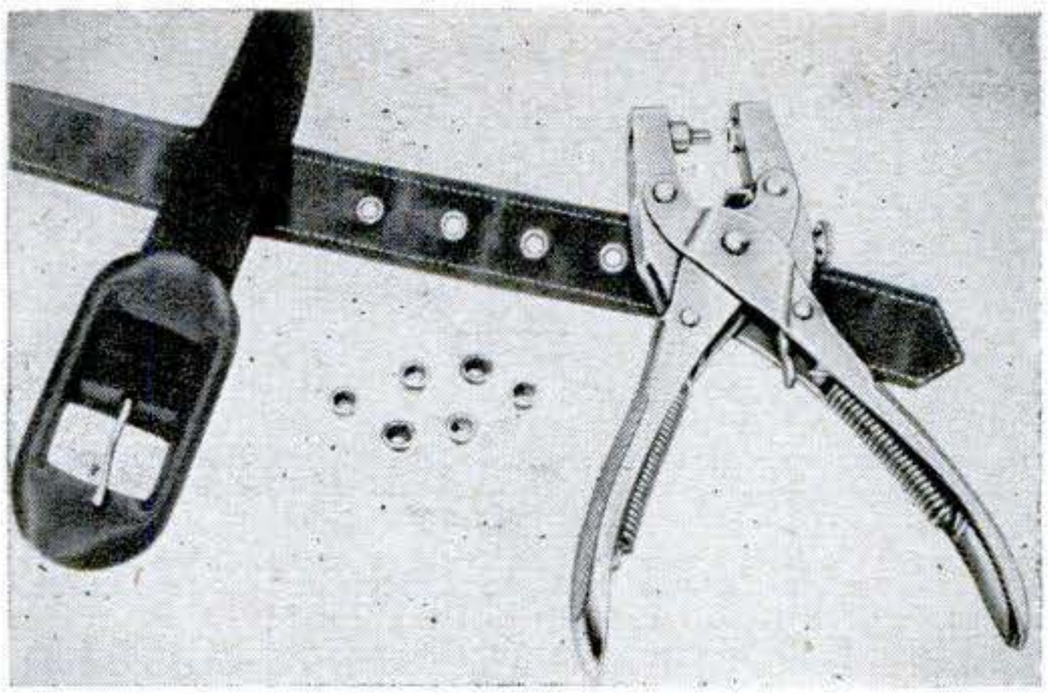

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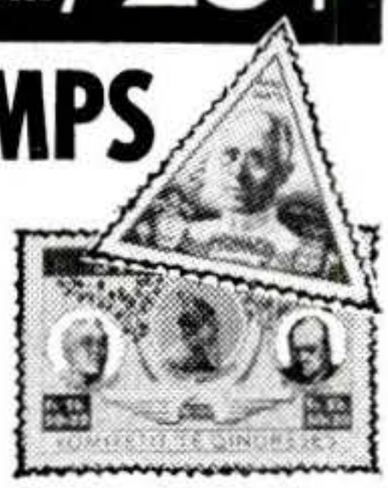

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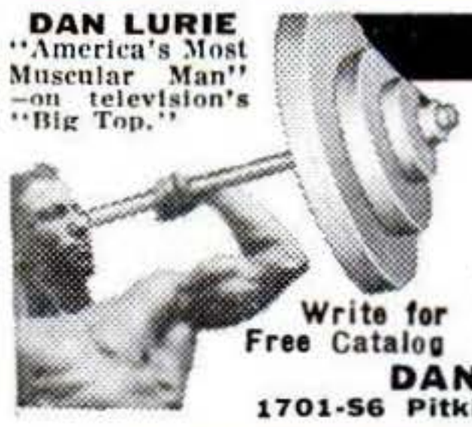

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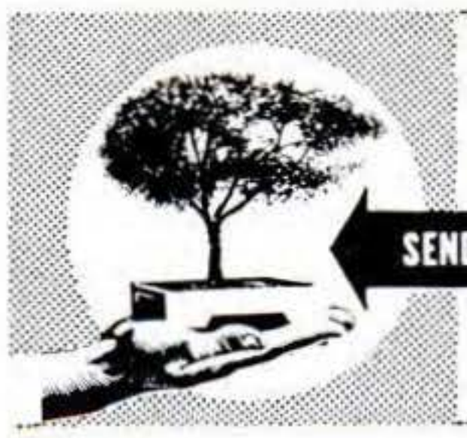

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700-16	6.45	760-15	6.05	750-15	13.95	900-20	17.25
750-16	9.25	800-15	6.55	825-15	12.95	1000-20	17.75
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650-15	5.35	760-16	7.15	32x6(8)	11.15	1100-22	20.45
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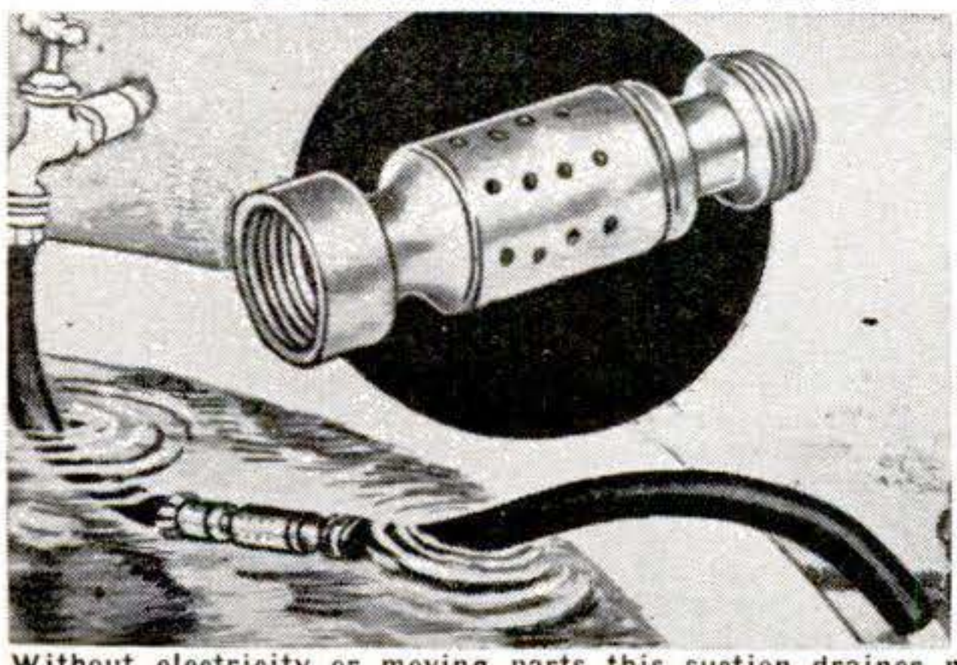

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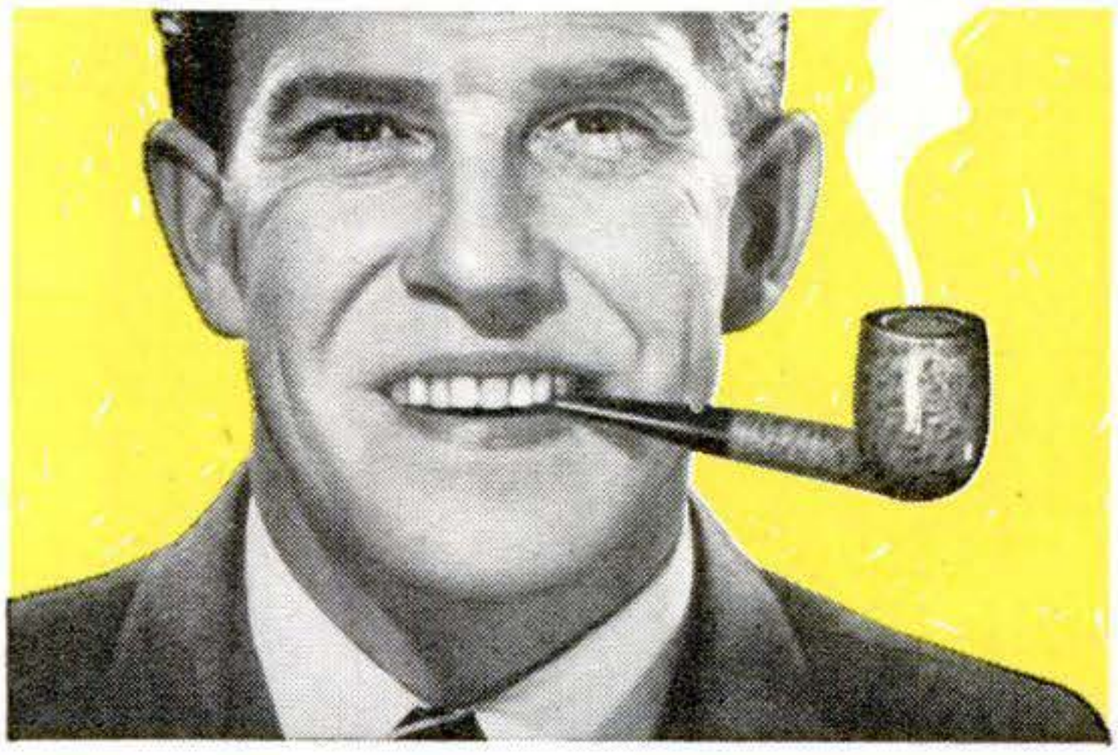

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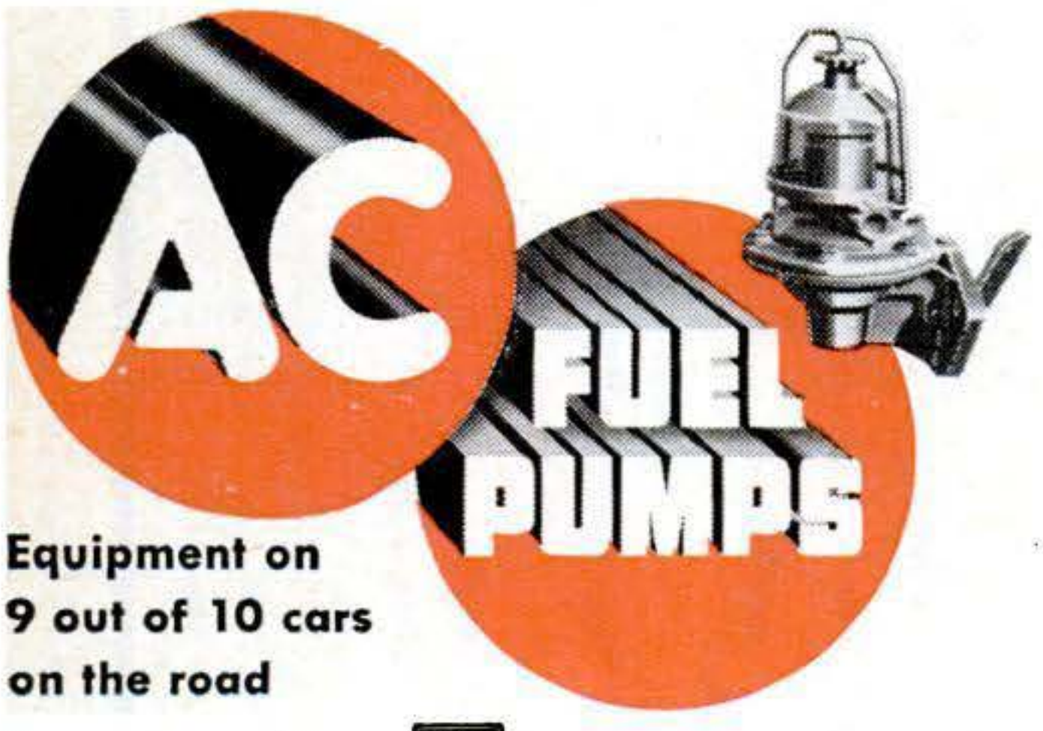

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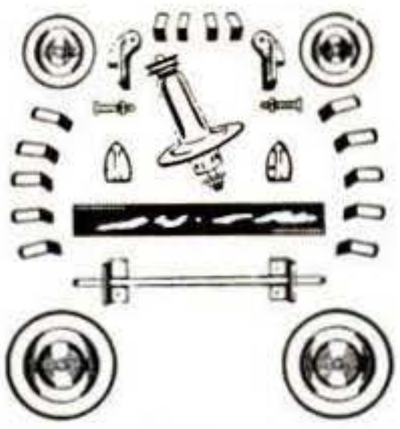

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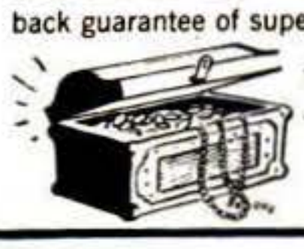

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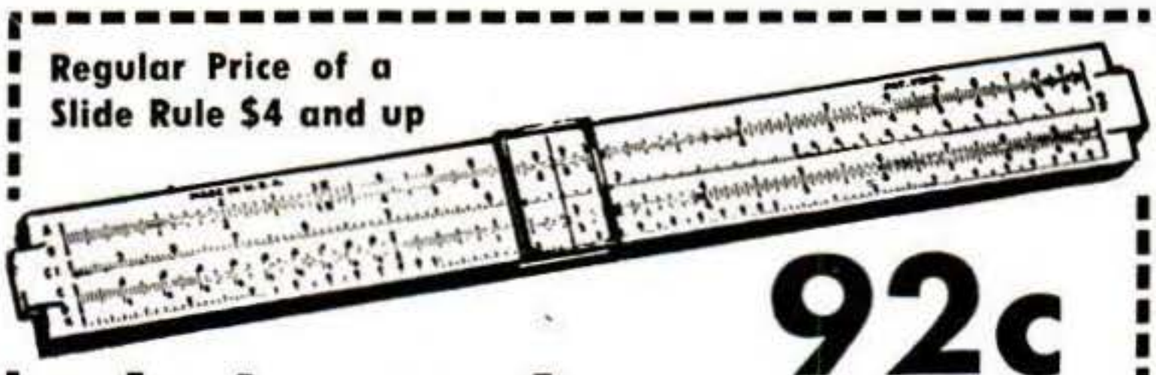

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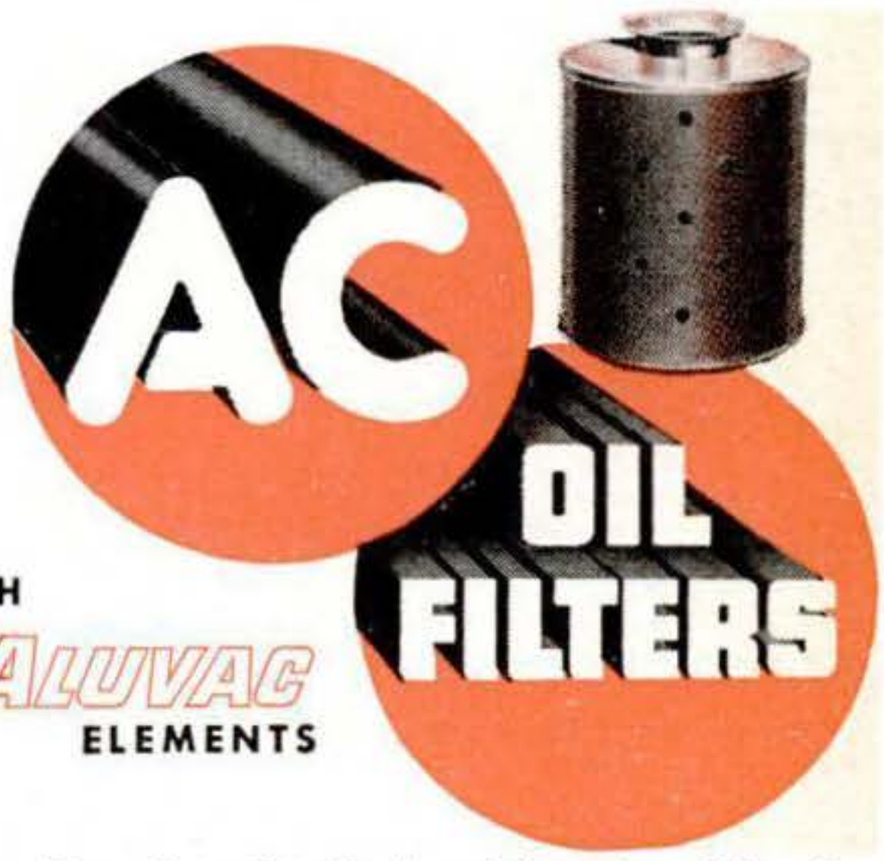

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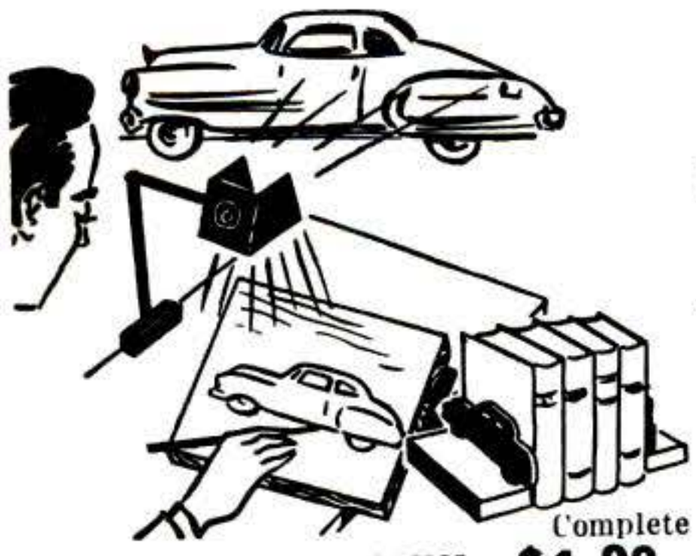

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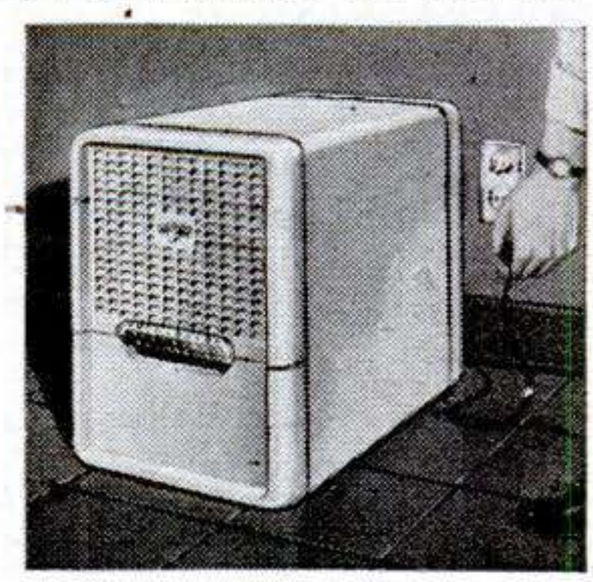

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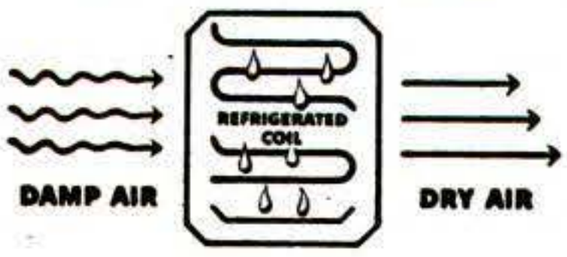

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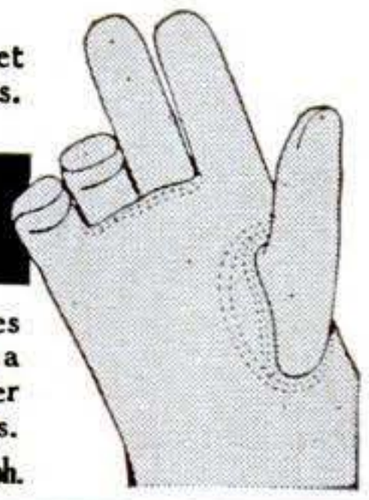

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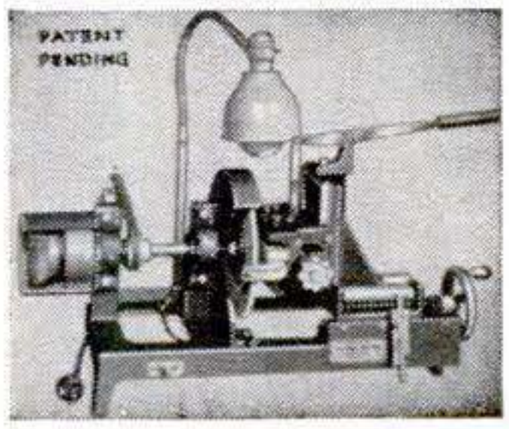

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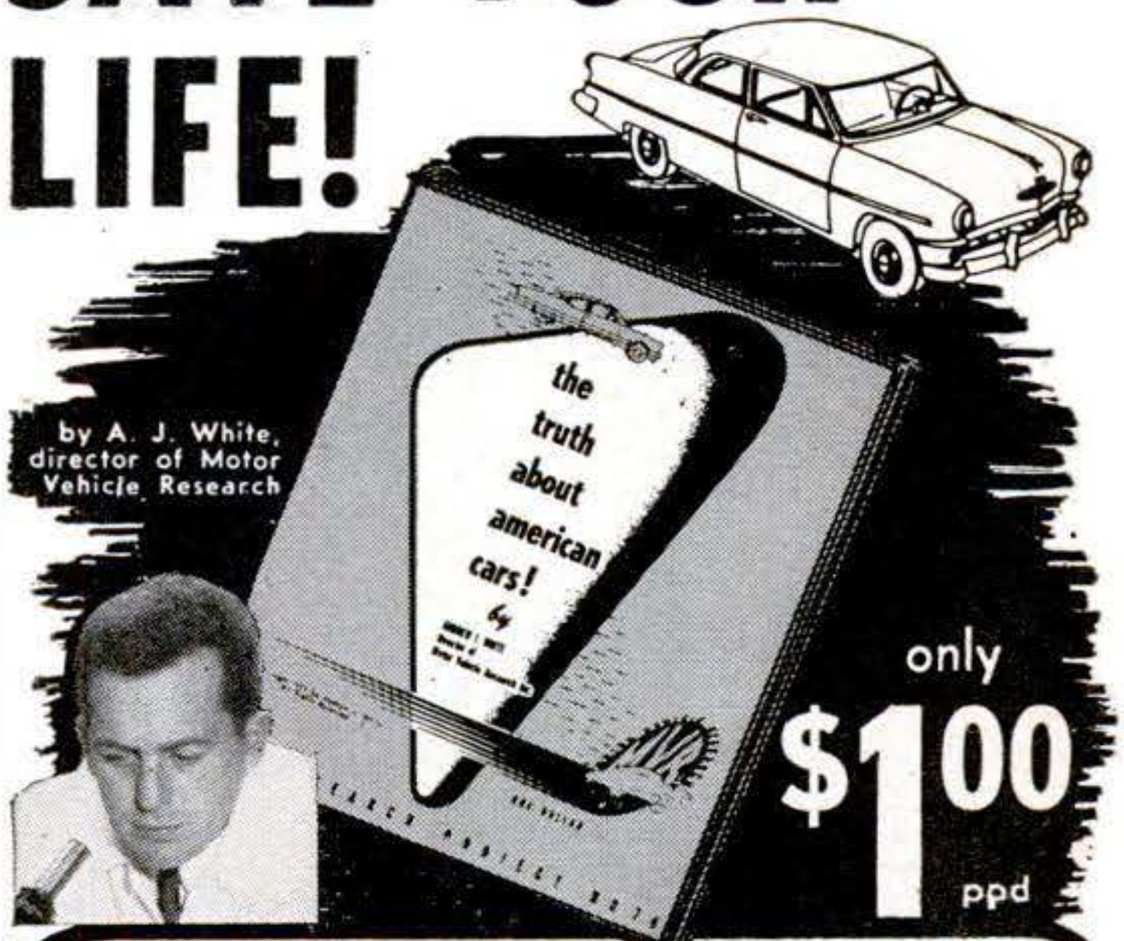

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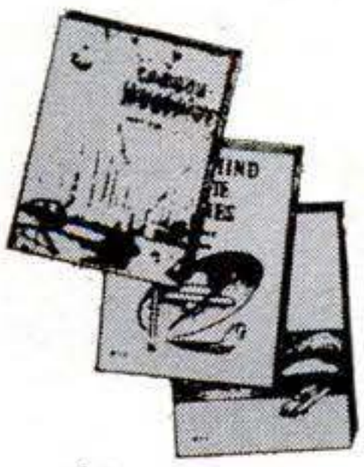

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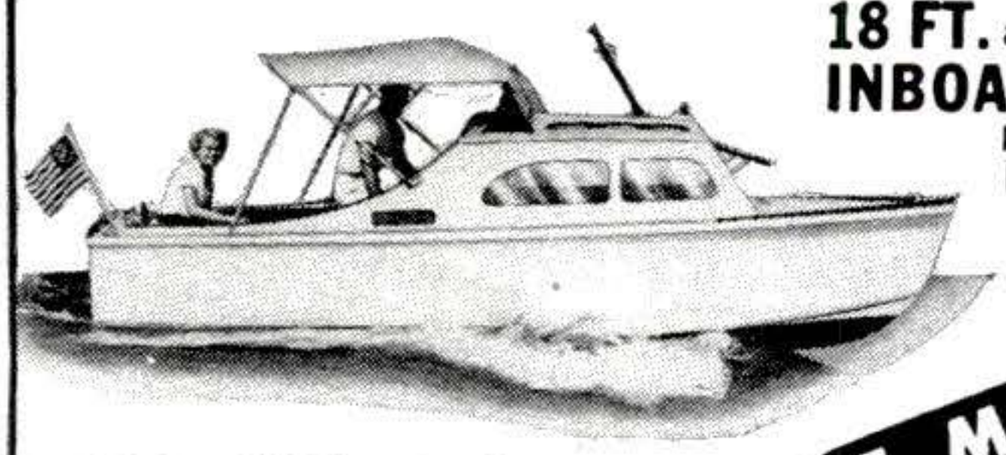

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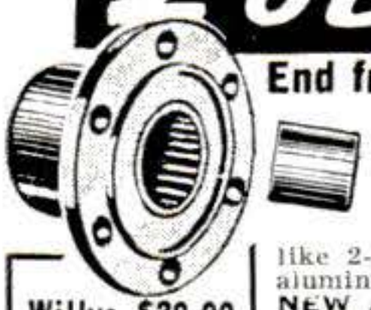

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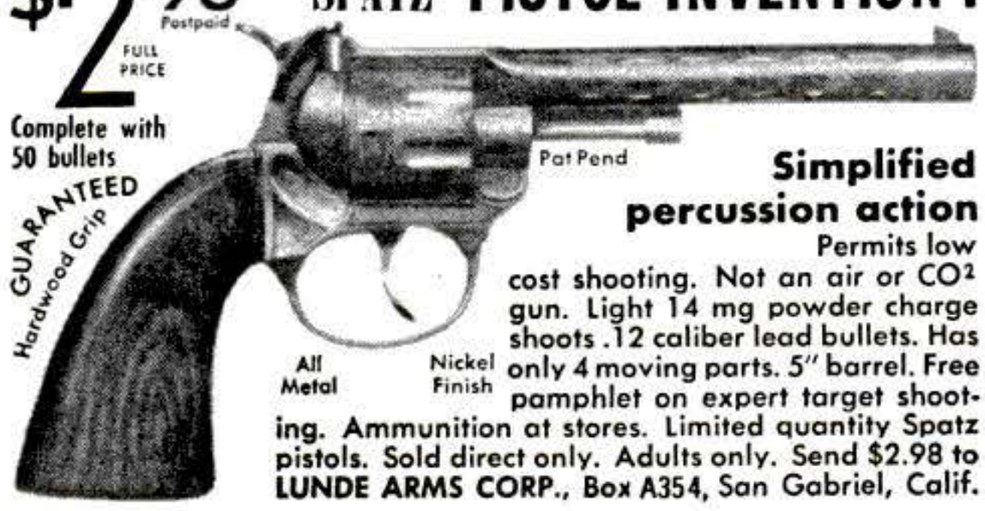

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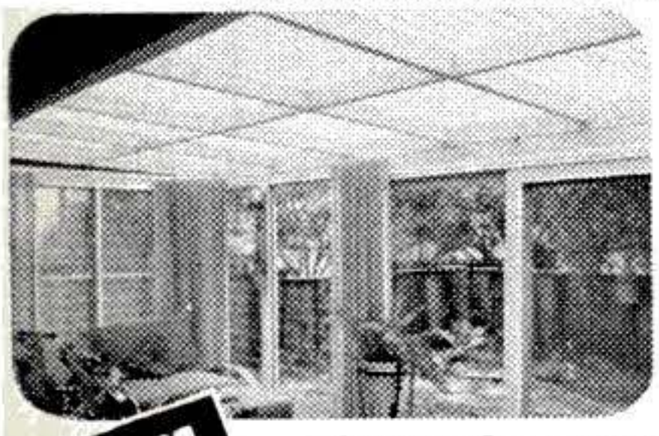

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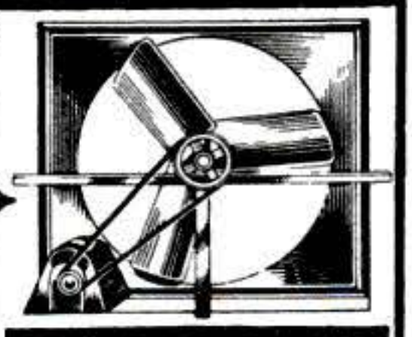

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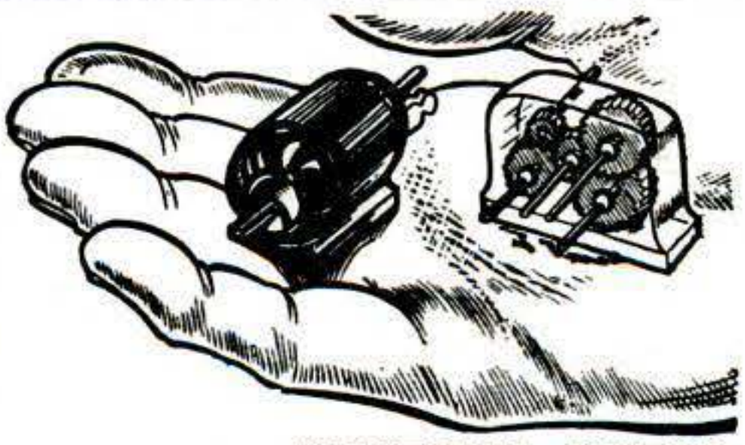

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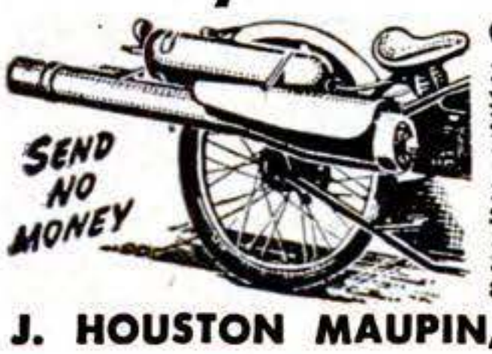

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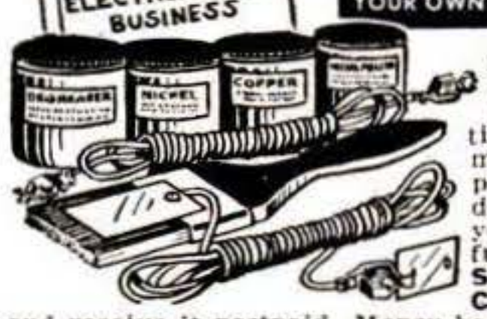

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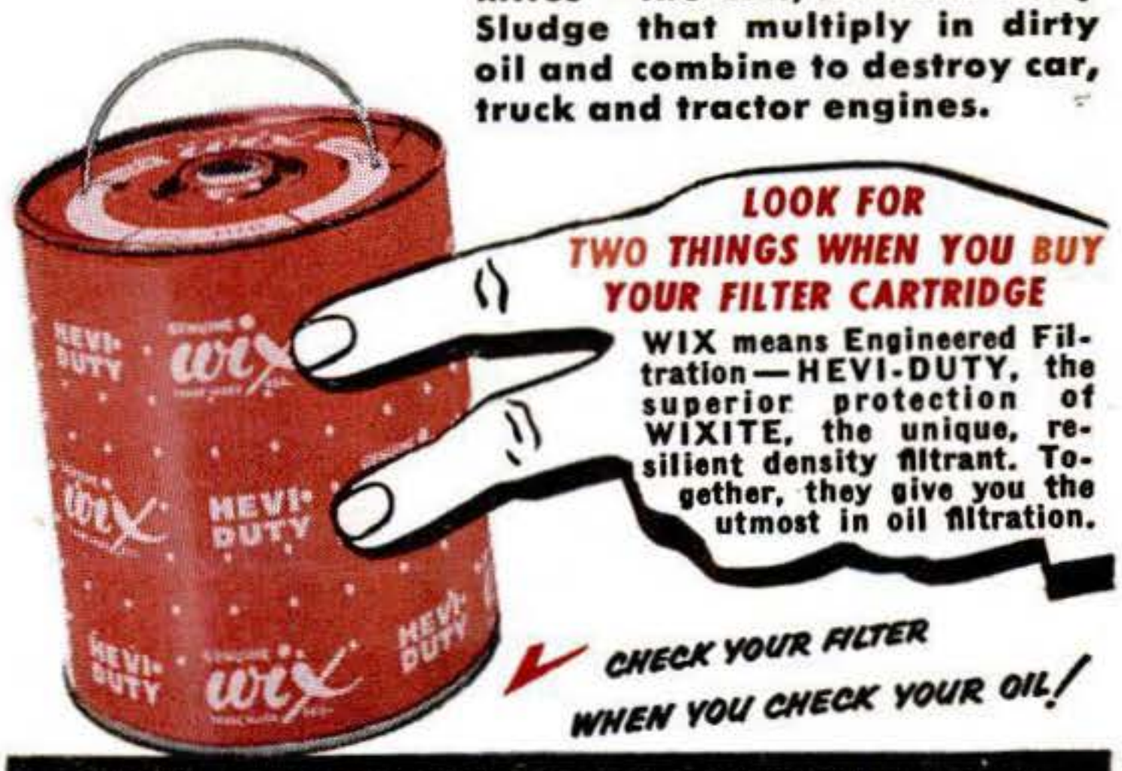

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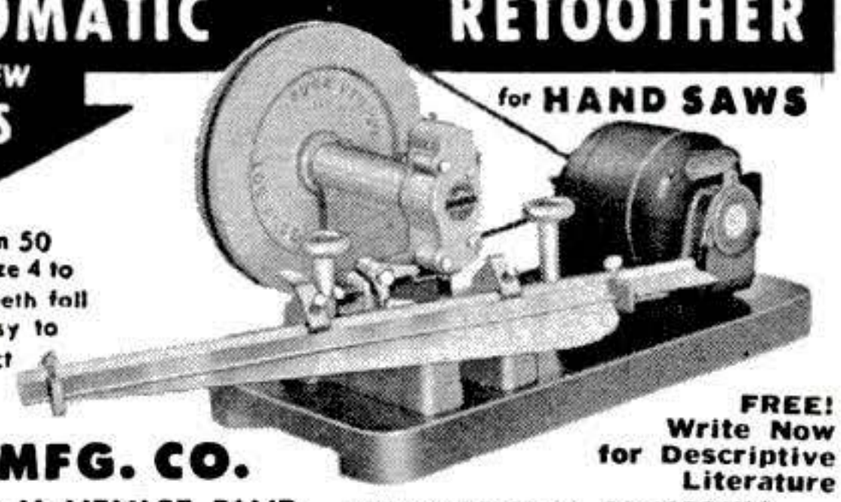

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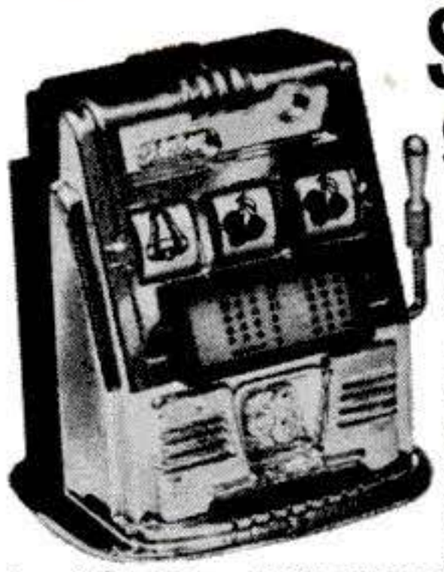

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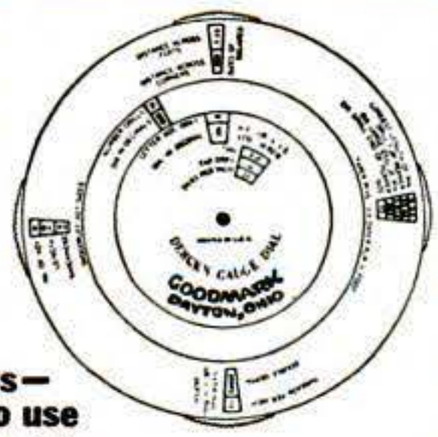

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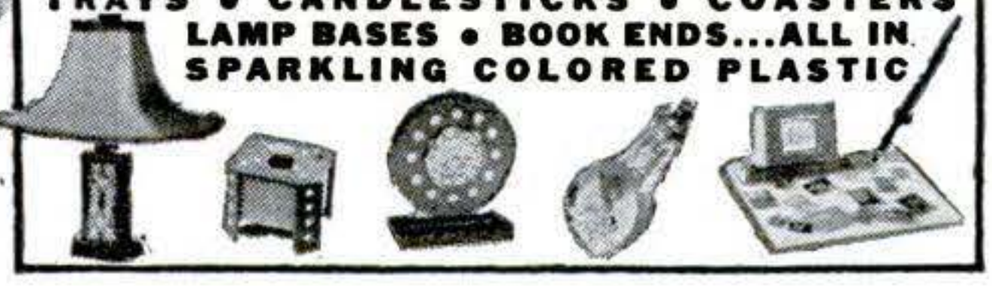

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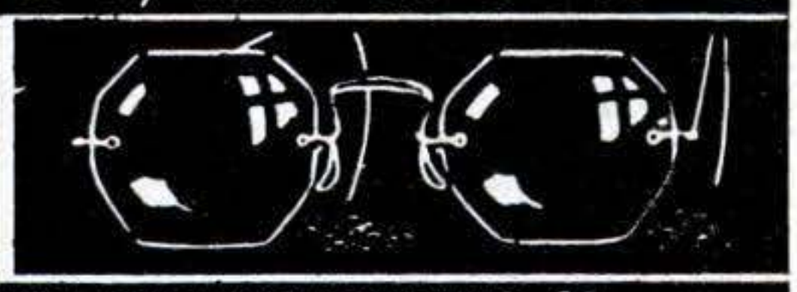

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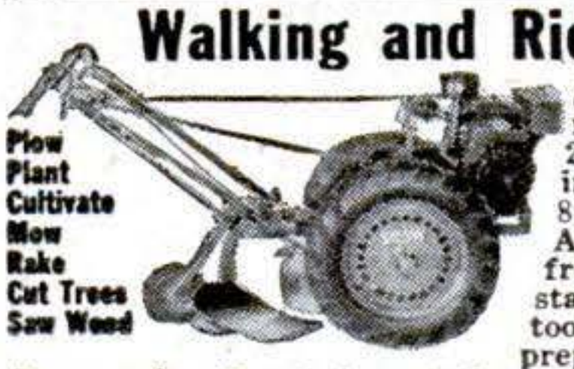

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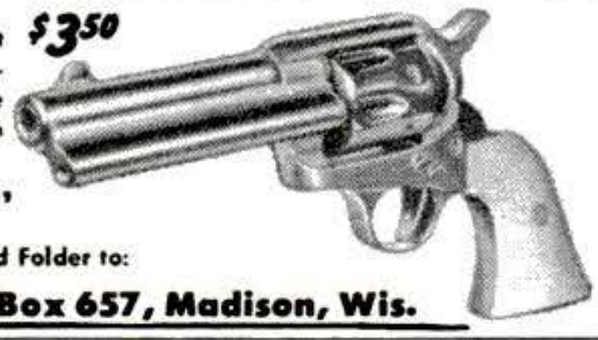

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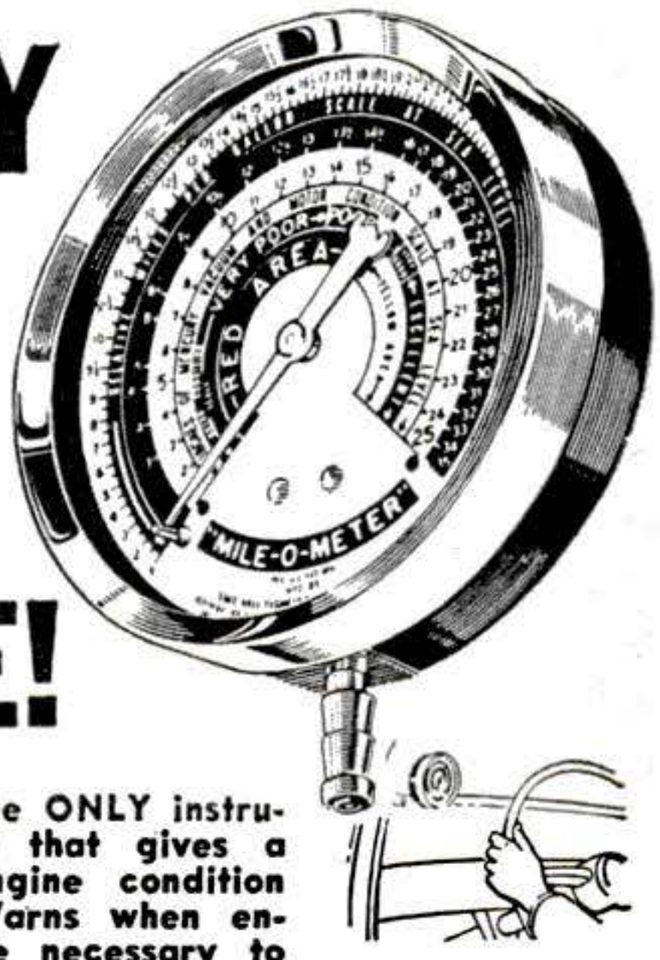

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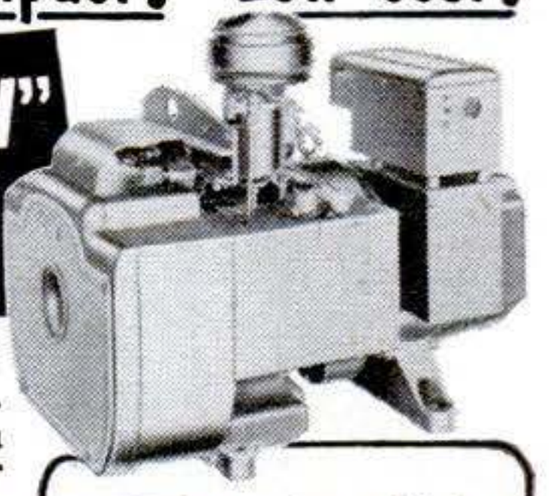

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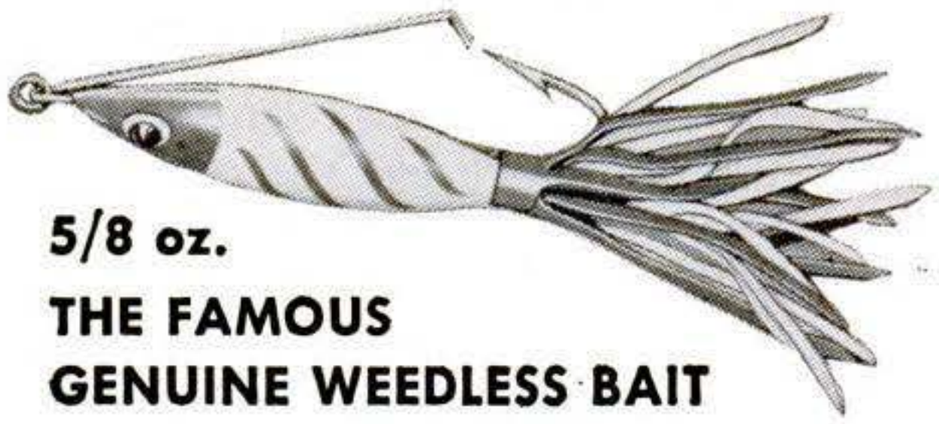

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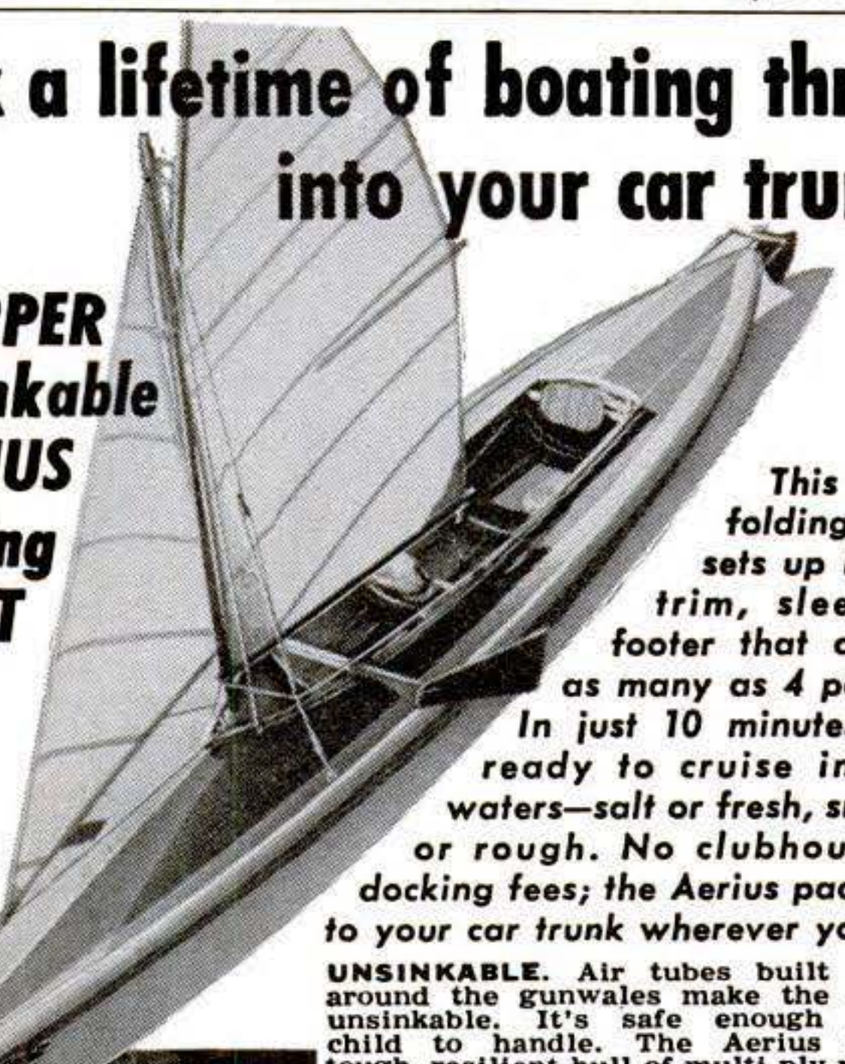

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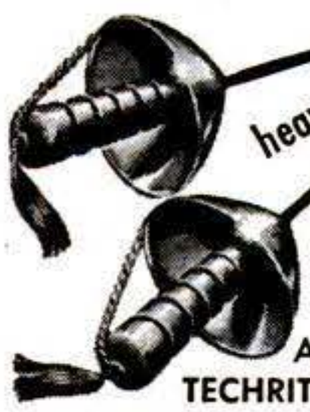

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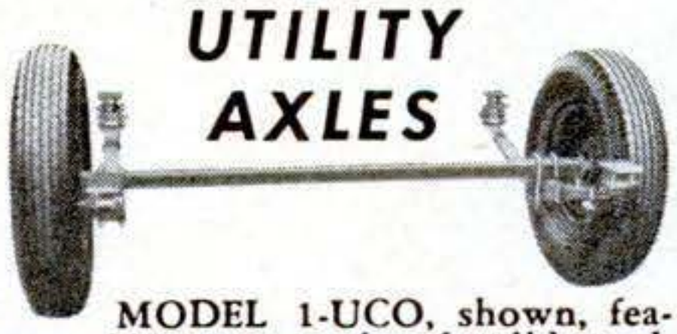

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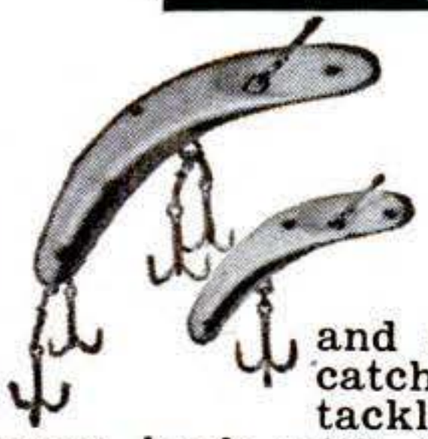

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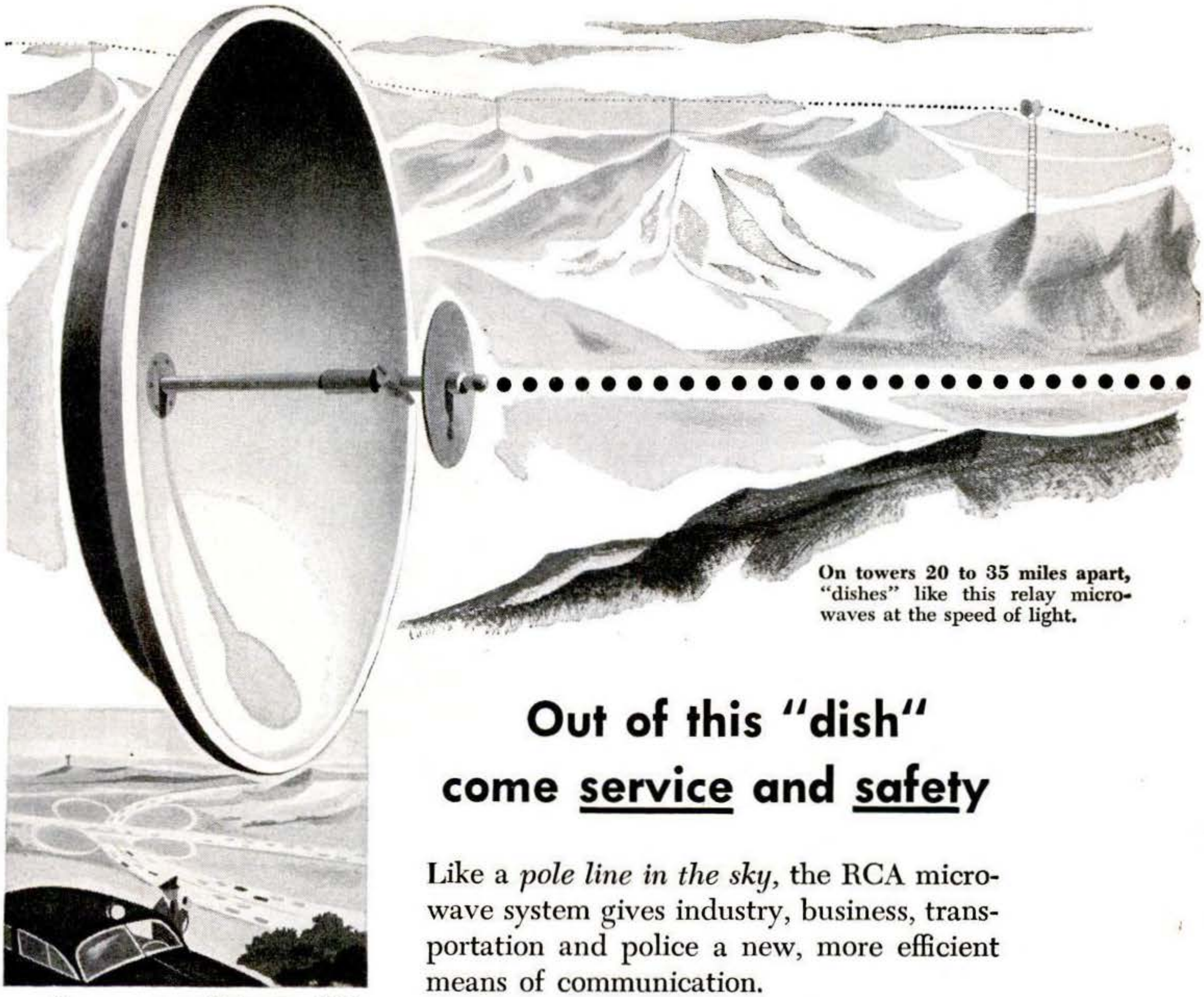

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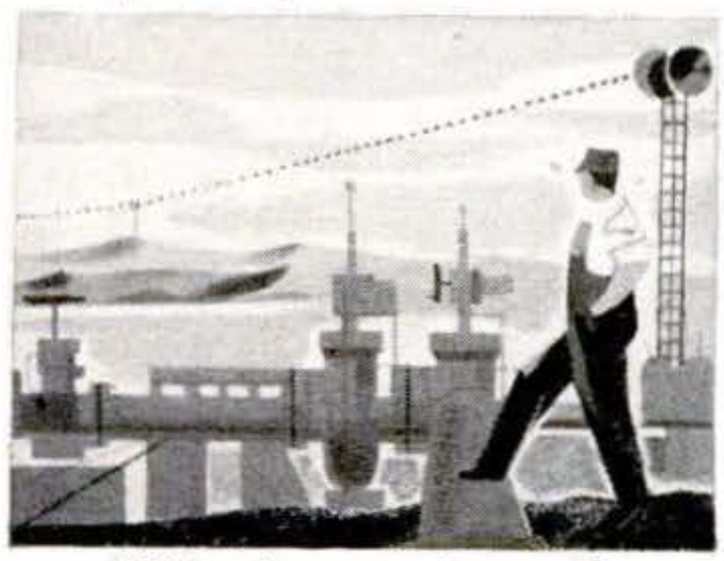

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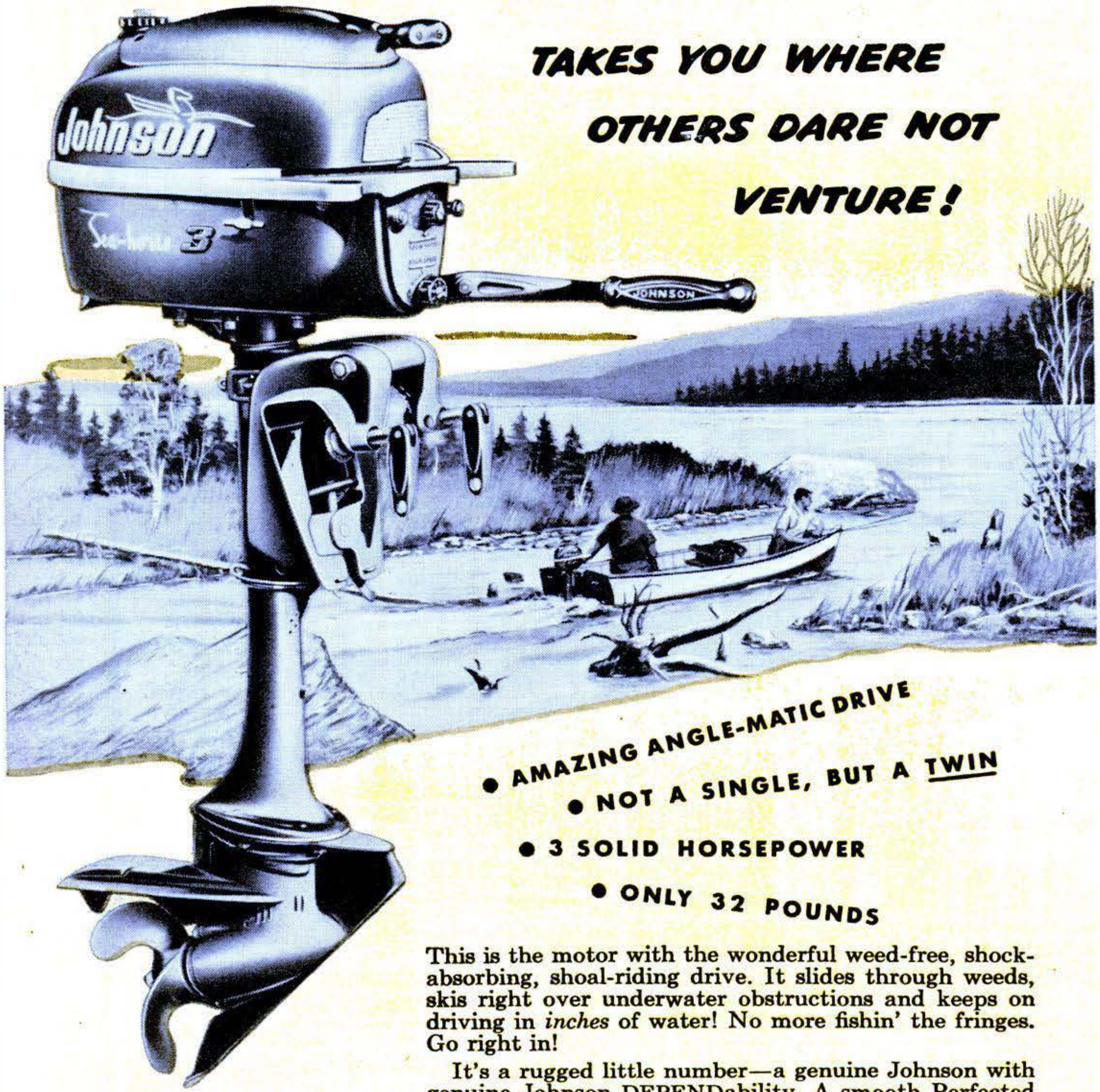

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WILBUR SHAW REPORTS ON A DIESEL CAR

"Fill'er Up with Fuel Oil"

A TAXI driver pulled up alongside me at a red light the other day and gave my automobile a quizzical going-over from front bumper to tail lights.

He had good reason. My engine was making with the noises like someone rattling a bucket of bolts. Anyone standing clear over on the curb would have sworn it was coming apart. But there was nothing wrong with it. It was built to sound that way.

I was driving one of the few Diesel-engine passenger cars in the U. S. It pings like crazy at idle. That's because the orifices in the fuel-injection nozzles

A MERCEDES-BENZ DIESEL gets a drink at a pump. The engine will burn anything from kerosene down to heating oil used in home furnaces—but the fuel must be filtered.

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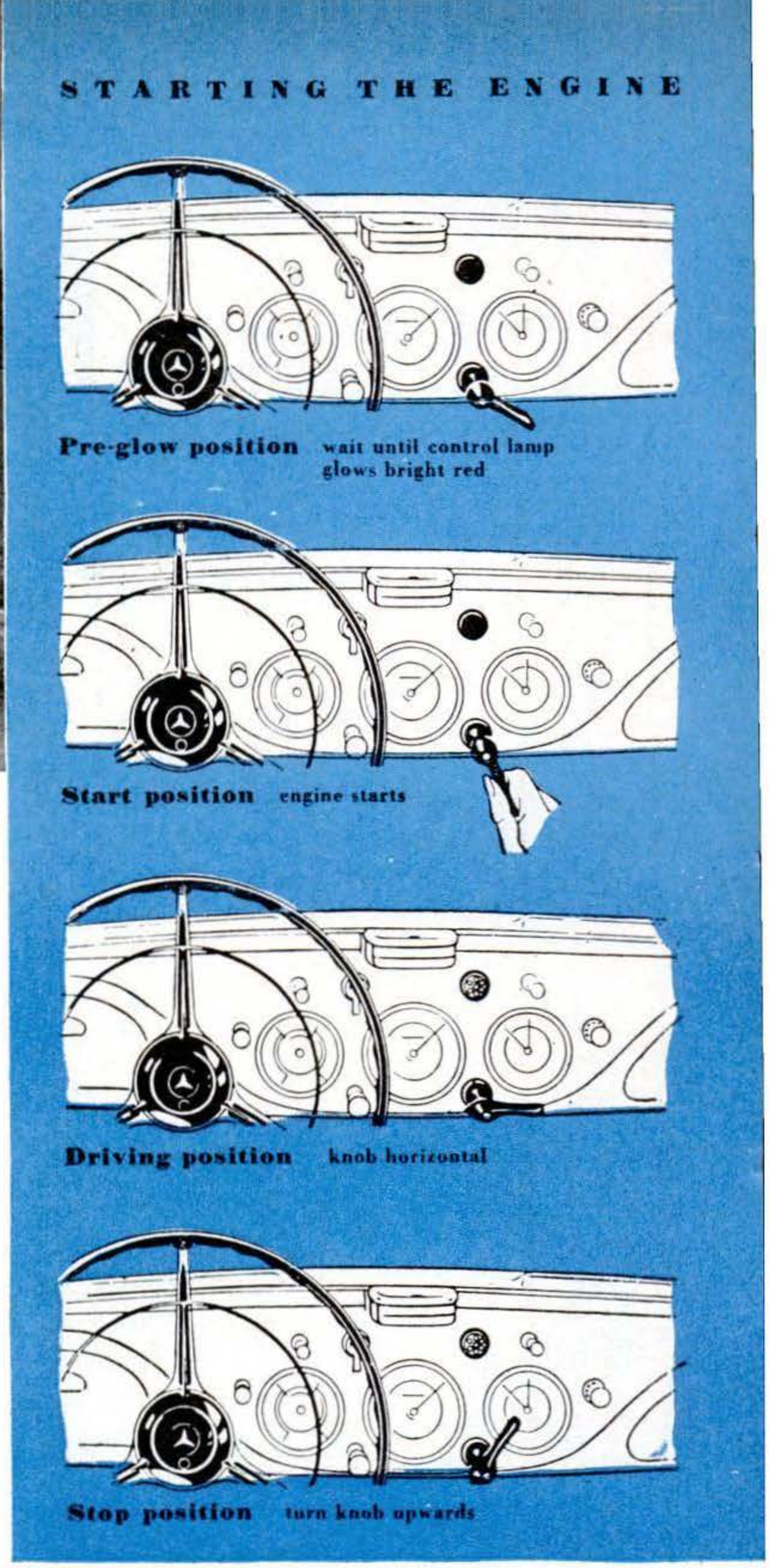
AMONG THE INSTRUMENTS is a glow-plug indicator lamp. It has to get red before you start the engine (see the panel at right). Battery-heated, plugs start combustion.



are sized for faster operation—at low speed the fuel isn't vaporized properly for good combustion-by-compression.

The engine may rattle, but this car will chug from New York to Los Angeles on $12 worth of fuel. It will run practically forever without attention. It will never have to have its valves ground for carbon. Its owner will never have to replace spark plugs or file the points on the distributor—it hasn't got any.

Economy, efficiency and trouble-free operation are Diesel characteristics. That's on the credit side. There *are* debits.

I borrowed this Diesel car, made by Mercedes-Benz—the same people whose gasoline cars took both first and second places in the Mexican Road Race last fall —from a New York physician. Dr. A. Schmidt-Baeumler bought it for the same reason that a man without a lathe will buy a set of turning chisels—he just likes Diesels.

"You think I'm crazy, eh?" remarked the doctor. He was poker-faced and I had to look twice to see the laugh behind his eyes.

No, he certainly wasn't crazy. His automobile, made in Stuttgart, Germany, has conservative styling that will look good 10 years from now. The workmanship on it is superb. It's of a size that ultimately we will accept in the United States. And it has performance that only owning it can prove. Remember that performance covers more items than take-off and speed.

The good doctor had to show me how to fire up. The engine started right off. The first thing I noticed was the noise. That stopped as soon as we got under way and I put a few more revs on the crankshaft.

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Acceleration was slow. A little gasoline-powered car beat me away from a stop light. A Diesel won't wind up as much as a gasoline engine. The top r.p.m. on the doctor's Diesel is 3,300. That on a comparable Mercedes-Benz gasoline buggy, with exactly the same piston displacement, is 4,200.

The car didn't do so well on hills, either. I had to be fast with the gearbox to keep from stalling. That's on account of the low horsepower—a mere 40 for a car weighing 2,800 pounds, about the weight of the new 104-hp. Hudson Jet.

But what would you expect from an engine delivering upward of 35 miles on a gallon of fuel that, incidentally, slugs you only half as much at the pump as premium gasoline does? The Diesel's top speed is around 60 miles an hour, but that's also its cruising speed. Just open 'er up. The engine was built to take it.

The doctor and I presently drew up at the curb. Not thinking, I turned the ignition switch to stop the engine. Nothing happened.

"Here," the doctor said. He turned a valve on the dash. That shut off the fuel. The engine stopped.

Back home, I looked up the pedigree on this car. It's the only Diesel passenger car in mass production in the world today. Mercedes-Benz makes a thousand of them a month. Dozens have been sold in the last year or two in California. That's because of the vast amount of Diesel trucking—the fuel is available practically everywhere. In the Midwest and East it's a different story. The doctor has to hunt for a filling station to serve him. And, particularly in the East, fuel prices are higher.

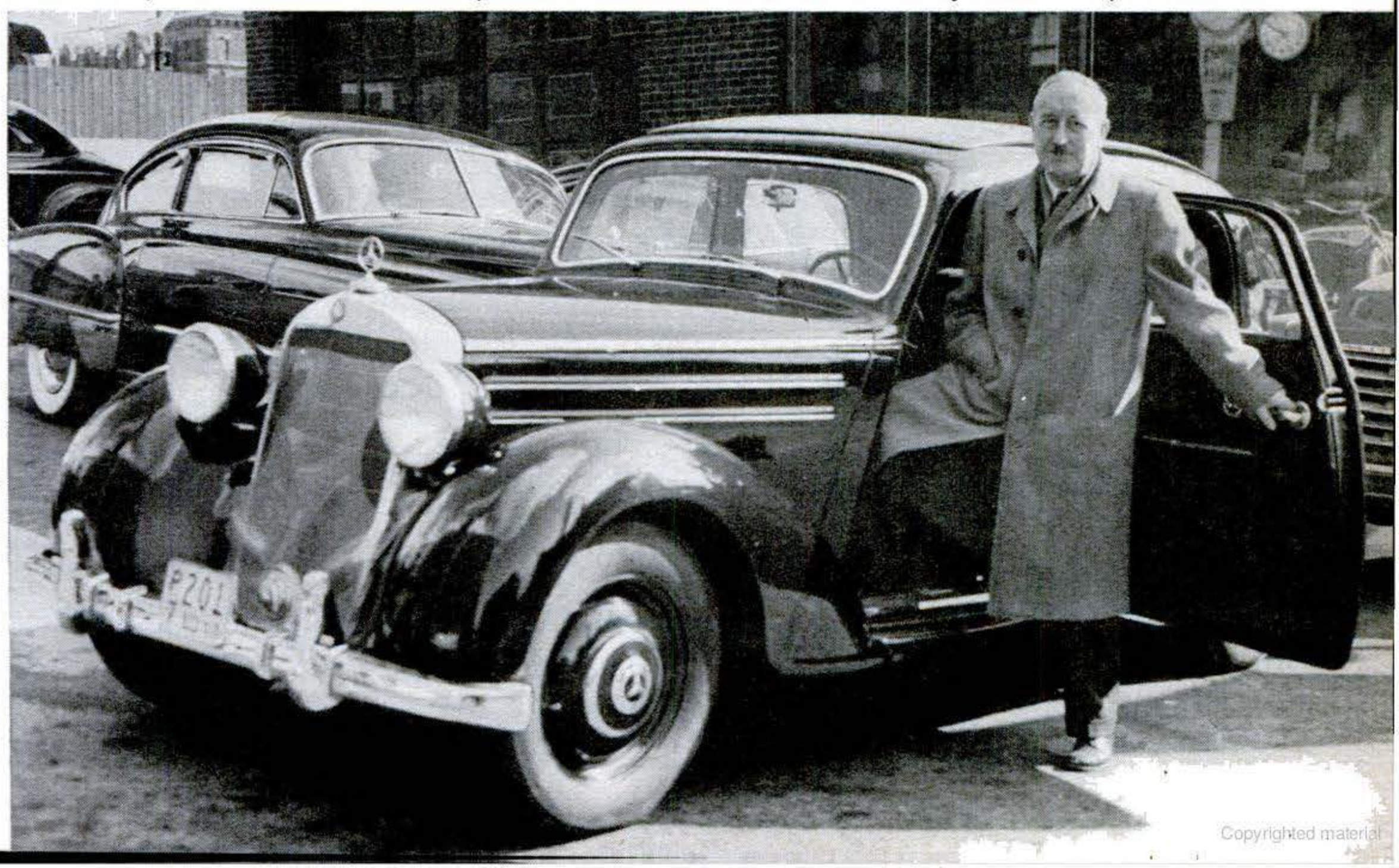
Diesel's Not Low-Priced

The car isn't cheap. It retails for about $3,600 in New York. Part of that cost is in expensive fuel-injection equipment. Like the Diesels made for trucks and buses, the most expensive single item on the Mercedes passenger Diesel is the fuel-injection pump.

The Diesel is an entirely different kind of internal-combustion engine from the gasoline engine. A gasoline engine converts only about a fourth of its fuel into power. A Diesel converts more than a third. Less heat (and therefore power) leaks from a Diesel's cylinders out the exhaust pipe. The fuel burns more slowly, and the long-stroke piston takes more advantage of the gas expansion.

A Diesel is more efficient even at light accelerator pressure—at low engine load, as the engineers say. That's because the

Mine host, Dr. Schmidt-Baeumler, and his Diesel. It looks like any other car, doesn't it?



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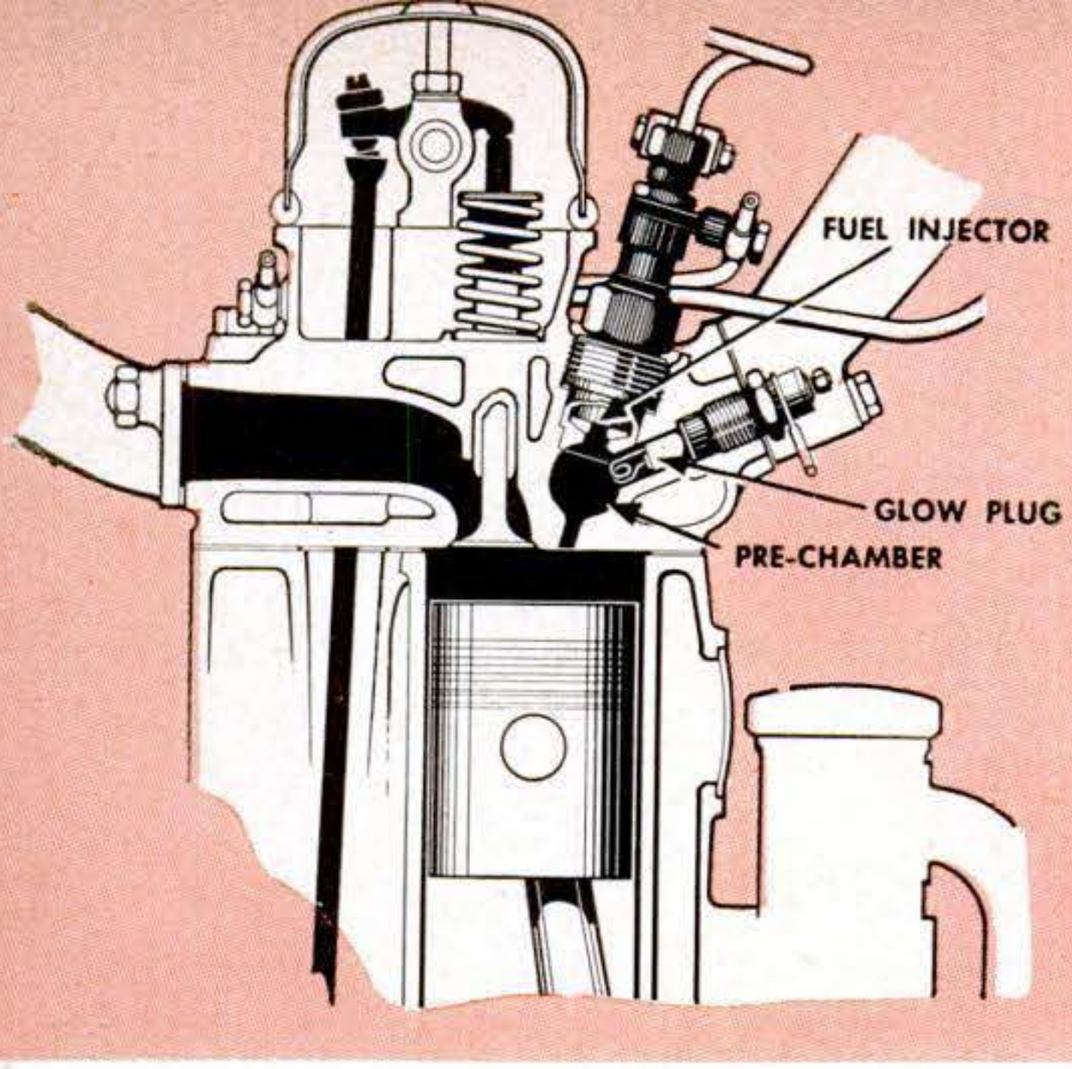

Here's What Makes Diesel Go

THE cutaway shows how the Mercedes squirts fuel into a "pre-chamber" instead of into the cylinder proper. This is to preheat the charge and get better combustion. As the fuel starts to ignite, temperature and pressure build up, spewing the rest of it into the cylinder. Just before combustion starts, the temperature (1,200 degrees F.) is 500 degrees hotter than in a gasoline engine with a 7-to-1 compression ratio. The pressure (640 lb. to square inch) is more than four times that in the gasoline engine.

amount of air in the cylinders, and therefore the compression pressure, is constant. When you reduce throttle on a gasoline engine, you begin to starve the cylinders and drop the compression pressure. The fuel doesn't burn as well.

High compression—in the Mercedes-Benz, it's 19 to 1—improves the combustion. But the engineers have to be careful in boosting the compression ratio of a gasoline engine. Squeeze the fuel-air charge too much, and it will ignite prematurely by itself. A Diesel engineer doesn't have to worry about that. As the piston comes up in the normal operating range, the cylinder contains nothing but air until the fuel is squirted in.

Open the throttle on a Diesel, and all that happens is that the fuel nozzles deliver more fuel—metered correctly to each cylinder. There's no spark, and the air supply arrives in each cylinder through its own inlet port. There's no pre-mixing of gas and air. Moreover, there is always more than enough oxygen present to burn the fuel delivered. And when you see a Diesel smoking, it's merely improperly adjusted.

Open the throttle on a gasoline engine, and the carburetor does a commendable but imprecise job of pre-mixing additional air and additional fuel at a ratio (by weight) of 15 to 1. Flowing into the intake manifold, this mixture alters in ratio as some of the gas comes out of suspension and is deposited on the walls. Seldom do any two cylinders get exactly the same-sized charge. Then ignition has to take place. That's complicated because automatic devices have to advance spark as the engine revs up.

[Continued on page 250]

FACTS ON MERCEDES-BENZ DIESEL

Model: 170 DS 4-door sedan.

Engine: 4-cyl. overhead valve; 40 hp. at 3,200 r.p.m.; compression ratio, 19:1; piston displacement, 107.8 cu. in.; piston travel (in feet per car mile at 20 m.p.h.), 2,085; bore and stroke, 2.9" by 3.9"; torque, 74.9 lb.-ft. at 2,000 r.p.m.

Weight: 2,810 lb.; per hp., 70 lb.

Transmission: 4-speed synchromesh; rear-axle ratio, 4.1:1.

Steering: 2½ turns lock to lock; radius of turning circle, 18'.

Effective brake-lining area: 114 sq. in.

Springs: coil, front and rear; independent wheel suspension, front and rear.

Outside dimensions: height, 63.39"; over-all length with bumpers and guards, 175.39"; width, 66.32"; wheelbase, 111.9"; overhang, front 23", rear 39.7"; tread, front 51.7", rear 53.5".

Inside dimensions: seat-cushion width, front 50.5" (total for split seat), rear 51"; leg room, front 43", rear 28"; headroom, front 38.8", rear 38.4"; seat height, front 12", rear 15½"; vertical distance, steering wheel to seat cushion with seat in mid-position, 7.2"; front-seat adjustment, horizontal 9", vertical 0".

Tire size: 5.50 by 16.

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Masked Gunmen Test Rifles in Deep Freeze

THESE men are not re-enacting the great Brink's robbery. They are armorers coming out of a new U.S. Armed Forces climatic chamber at Springfield, Mass., where they have been firing rifles at 70 degrees below zero. The weird attire protects them against the intense cold.

The test room behind them, resembling a huge walk-in refrigerator with walls a foot thick, is a hotbox as well as cold chamber. Its temperature can be varied from 85 degrees below zero to 175 above. In the higher temperature ranges, humidity is added to the air to simulate conditions in tropical jungles.

As various small arms are fired through open ports into armor-plated boxes filled with sand, still and motion pictures record the effects of extreme heat and cold on the weapons' action.

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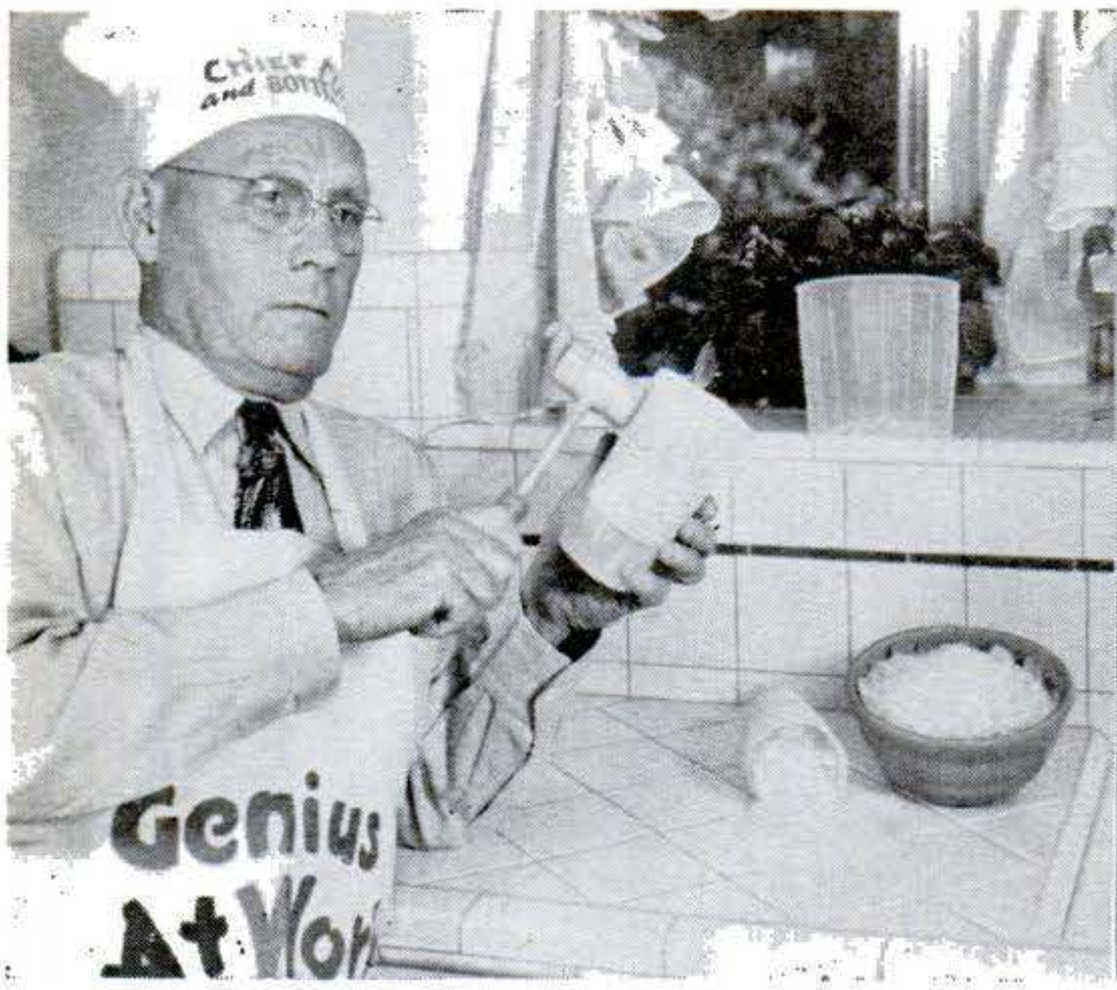
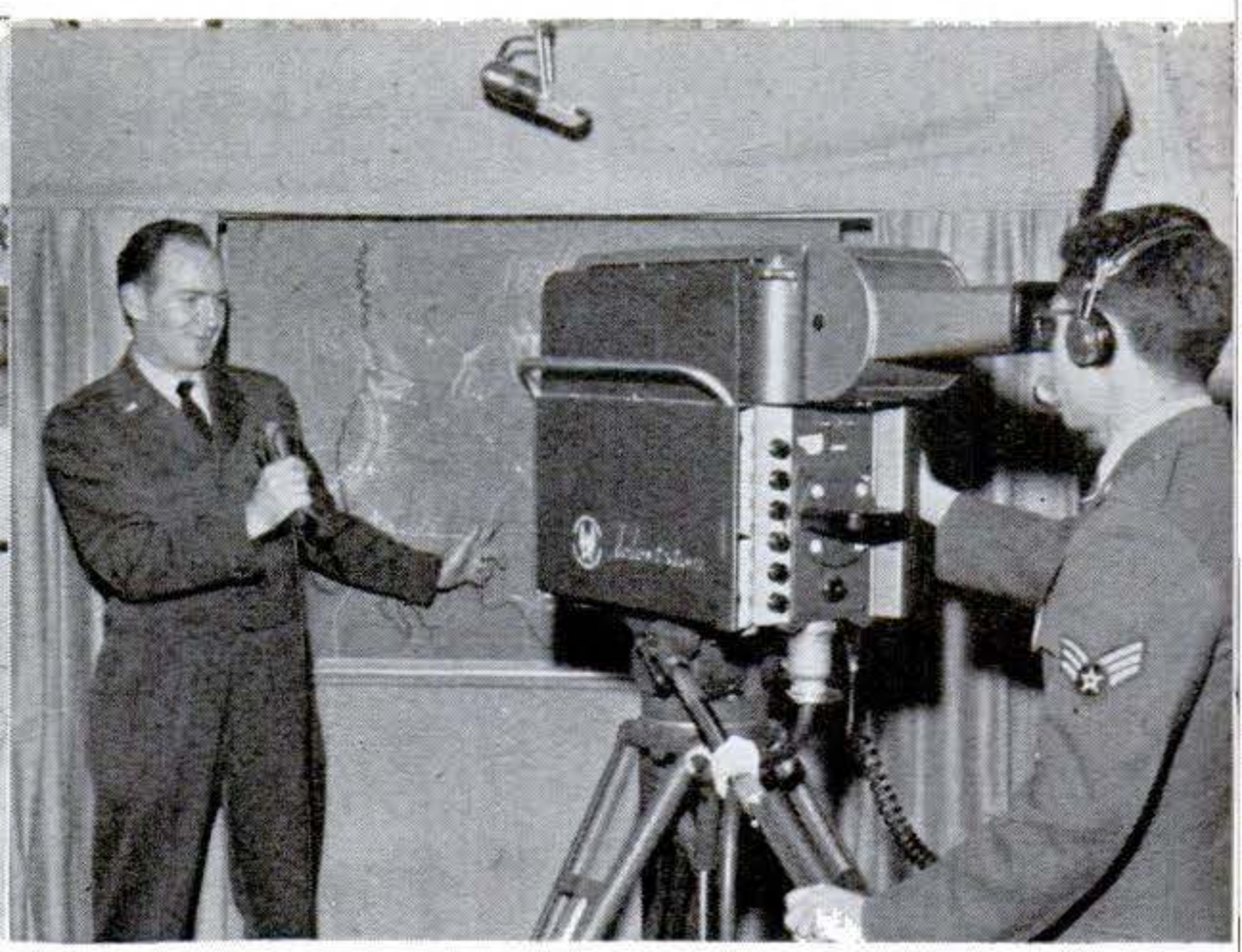


Ice Maker Crushes Ice, Too

RIBS molded into this plastic container are said to make ice chopping a chore that won't wreck the kitchen. After the water is frozen, you give the container a few whacks at strategic spots with a mallet and out flows crushed ice. The Pruett Novelty Works, Covina, Calif., makes the ice crusher.



TV Briefs Pilots on Weather

IF THE scramble order sounds, U. S. Air Force pilots at Hamilton Field, Calif., won't have to wait for weather briefing. An up-to-the-minute weather map, telecast from central headquarters, gives them a picture of conditions aloft and the best route to fly to any destination.

Turbo-Train to Run on Bottled Gas

EXPERIMENTAL PROPANE TENDER shown on opposite page is a standard tank car equipped with engine-deck-level platforms, leakproof fuel connections and high-speed trucks. If gas proves superior to Bunker C oil, tomorrow's gas-turbine locomotive may sport an enclosed-corridor tender of the type pictured above.

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Supersonic French Jet Carries Engines on Wing Tips

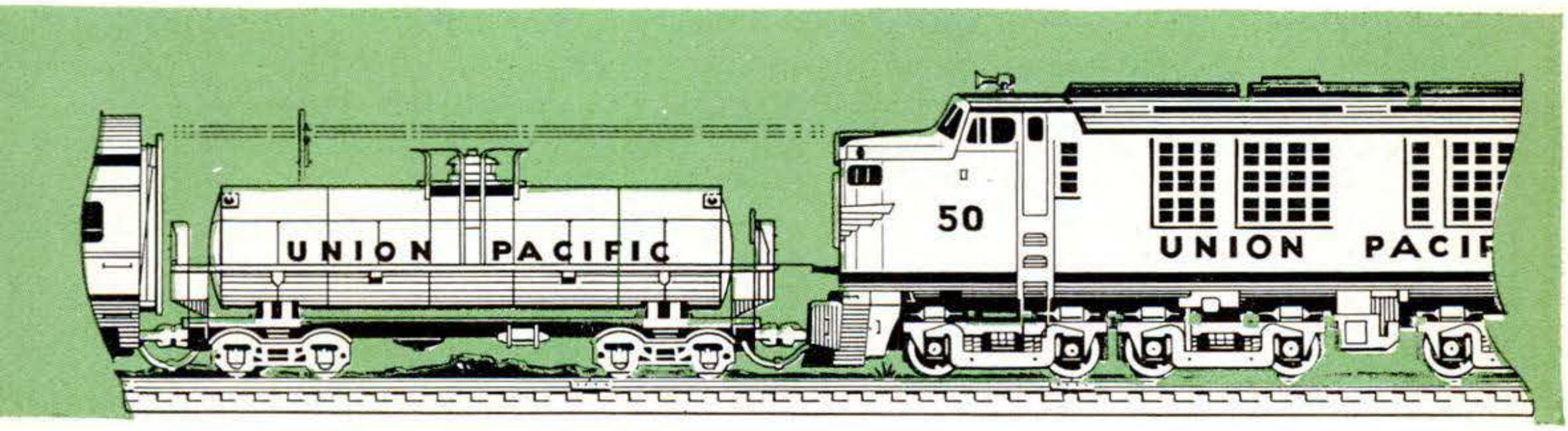
FIRST French plane to crash the sonic barrier in horizontal flight, the Trident, above, packs its jet engines in wing-tip nacelles. The speedy interceptor also carries a rocket in the tail, to give it a very fast rate of climb. Once the rocket fuel is exhausted, the plane's light weight gives it a lower landing speed than that of any other modern fighter. Small and inexpensive base facilities will accommodate it, and the relatively simple design of the plane will make it possible to turn out large numbers of the stubby-winged fighting ships quickly and at low cost.

SEVENTY-TWO years ago a steam locomotive was built to run on gas generated from naphtha and water. The experiment flopped, partly because the novel fuel had a tendency to clog the flues, but mainly because Erie Railroad engine crews refused to ride with so dangerous a cargo.

Today, the possibility of burning a gaseous hydrocarbon—propane—in a gas-turbine locomotive is being explored by the Union Pacific. Out of these experiments may come a brand-new kind of tender, tailored to meet the needs of tomorrow's super-locomotive.

In its first test of propane, the Union Pacific will haul along a remodeled tank car of the type now widely used to transport bottled gas. Built to withstand a pressure of 300 pounds to the square inch, it will carry 11,000 gallons of propane. A leak-proof, flexible connection will deliver the fuel to the turbines in the locomotive. There the performance of the propane will be checked against that of Bunker C oil—the fuel now used in the U.P.'s gas turbines.

If propane proves easier on the rotor blades than heavy oil, U.P. technicians believe that the greater space needed to store it will be justified. Look, then, for more scientifically engineered propane tenders, designed to blend with streamlined locomotive units.—*Henry B. Comstock.*



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This

Come for a dizzy spin in this tiny, fast and rugged acrobat on wheels. Its performance and antics amaze even its designer.

By Joseph Hines

RESIDENTS along a road outside Wheatland, Pa., near the Ohio border, are getting popeyed watching the daily performance of a new car. Some of its tricks would make any sensible mule hesitate.

The Mighty Mite is its name. The Marines are testing it as a quarter-ton transport vehicle for airborne assaults.

PSM photographer Bill Morris has covered about every type of new car, civilian and military, produced during the last 13 years. He saw the first demonstration of the original jeep in 1941. He doesn't excite easily.

Bill got his first look at the Mighty Mite outside the Mid-America Research Corporation's plant at Wheatland, Pa. Ben F. Gregory, veteran racing driver and inventor, and an advocate of front-wheel drive for more than 30 years, was boasting about the prowess of his baby. He designed the original model of the Mite.

"It's got four wheels and looks like a small jeep to me," said Bill. "What's so different about it?"

"Jump in, Mr. Morris," Gregory said.

As the Mite started, I jumped back.

"Stay put," called out a mechanic. "He'll clear us. The thing has a turning radius of only 12½ feet."

A neat circle and the lightweight Mighty Mite was off toward the road.

One of the Mite's many weight-saving devices is an air-cooled engine. Because it was available for the first experimental models, a four-cylinder, horizontally opposed German Porsche, developing 44 horsepower at 4,000 r.p.m. was used.

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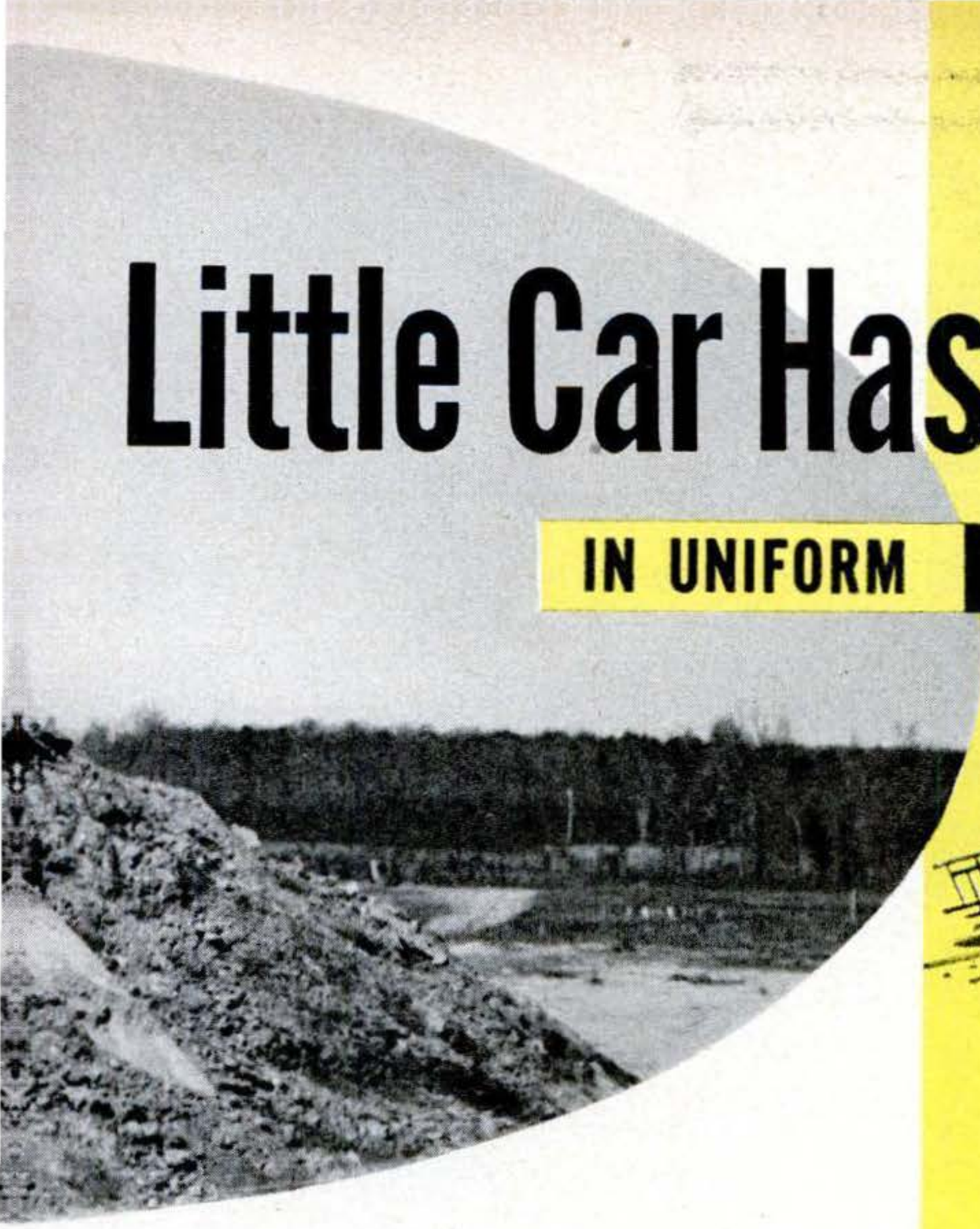
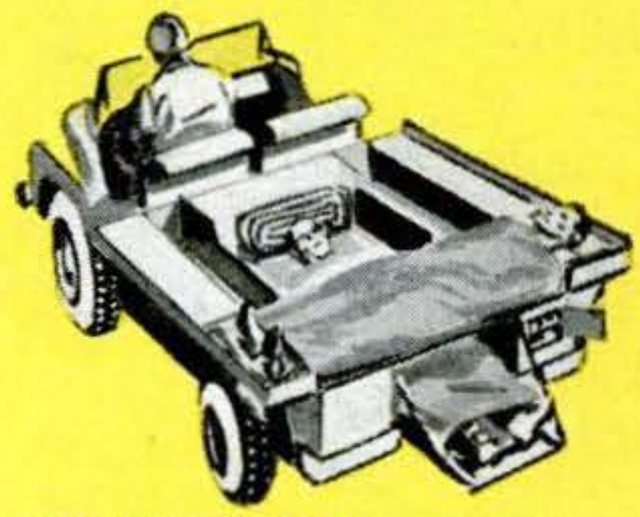
Little Car Has Big Ideas

IN UNIFORM **IN CIVVIES**



THE MIGHTY MITE tops an 87 percent grade at Marine Corps proving ground, Quantico, Va. Designed as a rugged, lightweight combat vehicle that can be lifted by helicopter, the new little car is also scheduled for a civilian career, as shown in drawings at right and below.

FOREST-FIRE TRUCK



RESCUE TRUCK

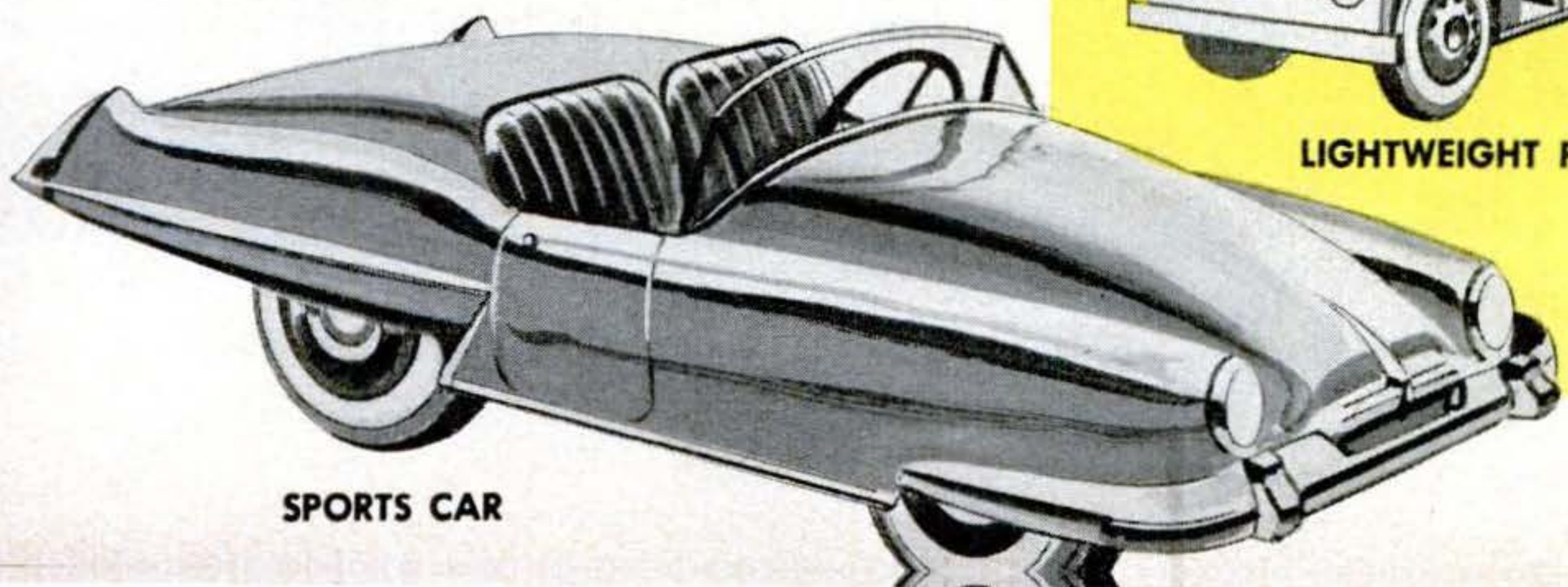
LIGHT DUMP TRUCK

LIGHTWEIGHT PANEL TRUCK

This probably will be replaced by a modified, American Lycoming aircraft engine of 65 horsepower at 2,600 r.p.m.

While we were looking over one of these Lycoming jobs, the Mighty Mite drove right into the shop. After tight-circling us, Gregory drove off through a maze of jigs, jamming on the brakes as he was headed for a crash through an office partition.

Bill Morris climbed out. His face was flushed, his thick mop of white hair windblown. He was breathing hard as the



SPORTS CAR

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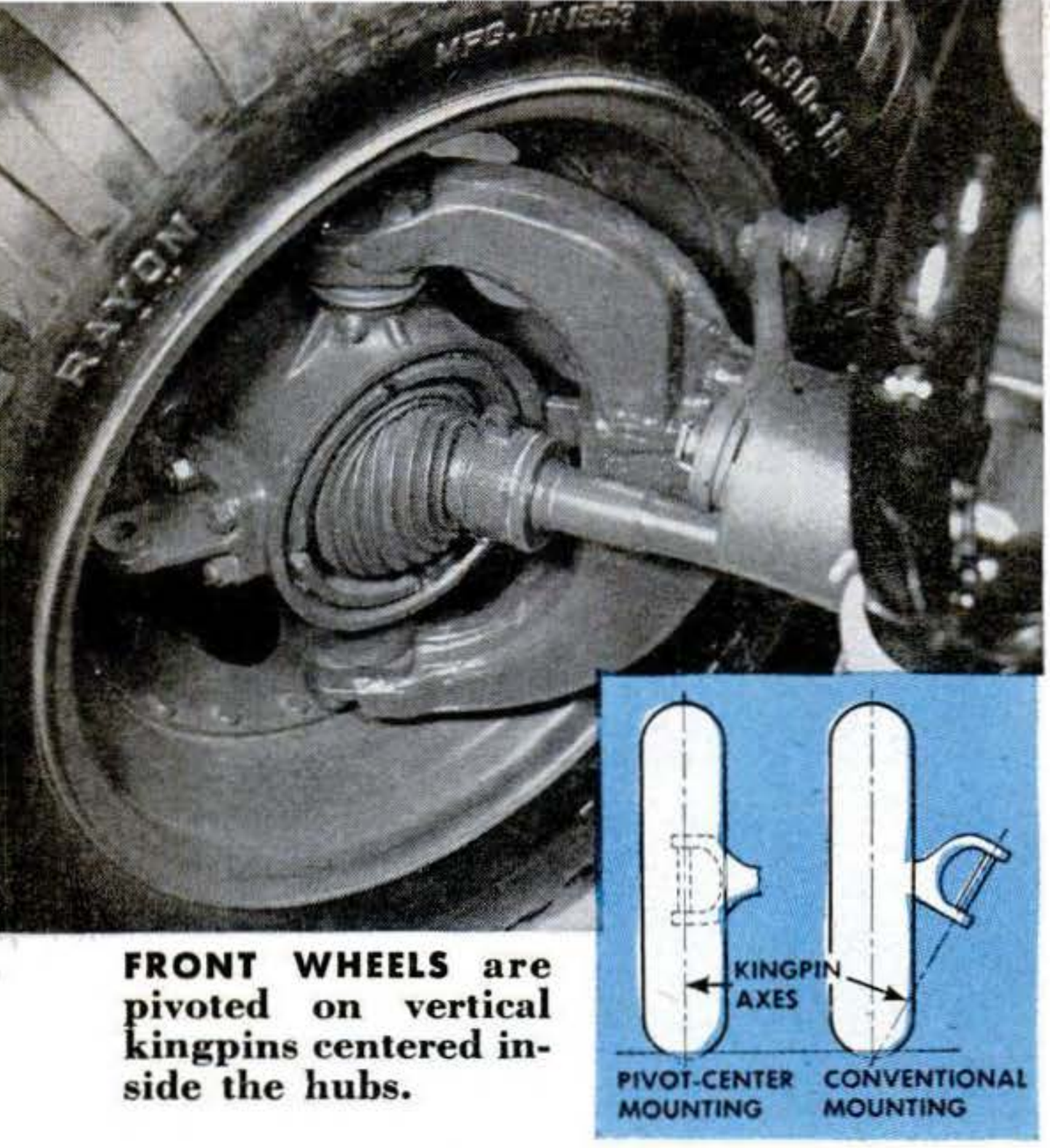


FRONT WHEELS are pivoted on vertical kingpins centered inside the hubs.

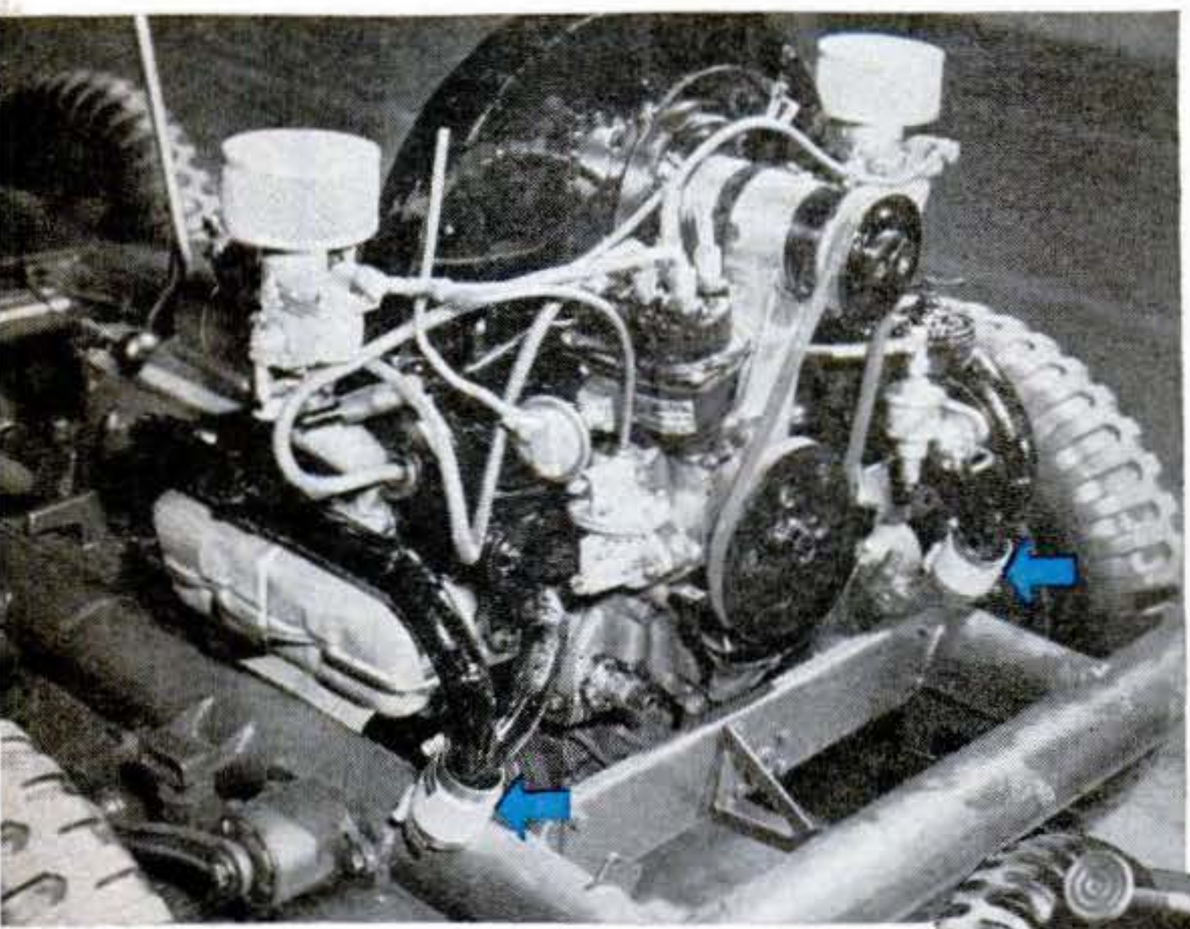
words came out, "Yes—yes it—it's different from a jeep. What a ride!"

Now it was my turn. We were doing better than 50 on smooth pavement when I saw double railroad tracks crossing the road ahead. Instead of slowing down, Gregory put on more speed. He told me to watch the steering wheel. I did. He had taken both hands off the wheel. I gripped a handle by the windshield. I didn't need to. The car didn't swerve or sway; the steering wheel didn't even wiggle. If I hadn't seen the tracks, I would have sworn that we were still on smooth pavement.

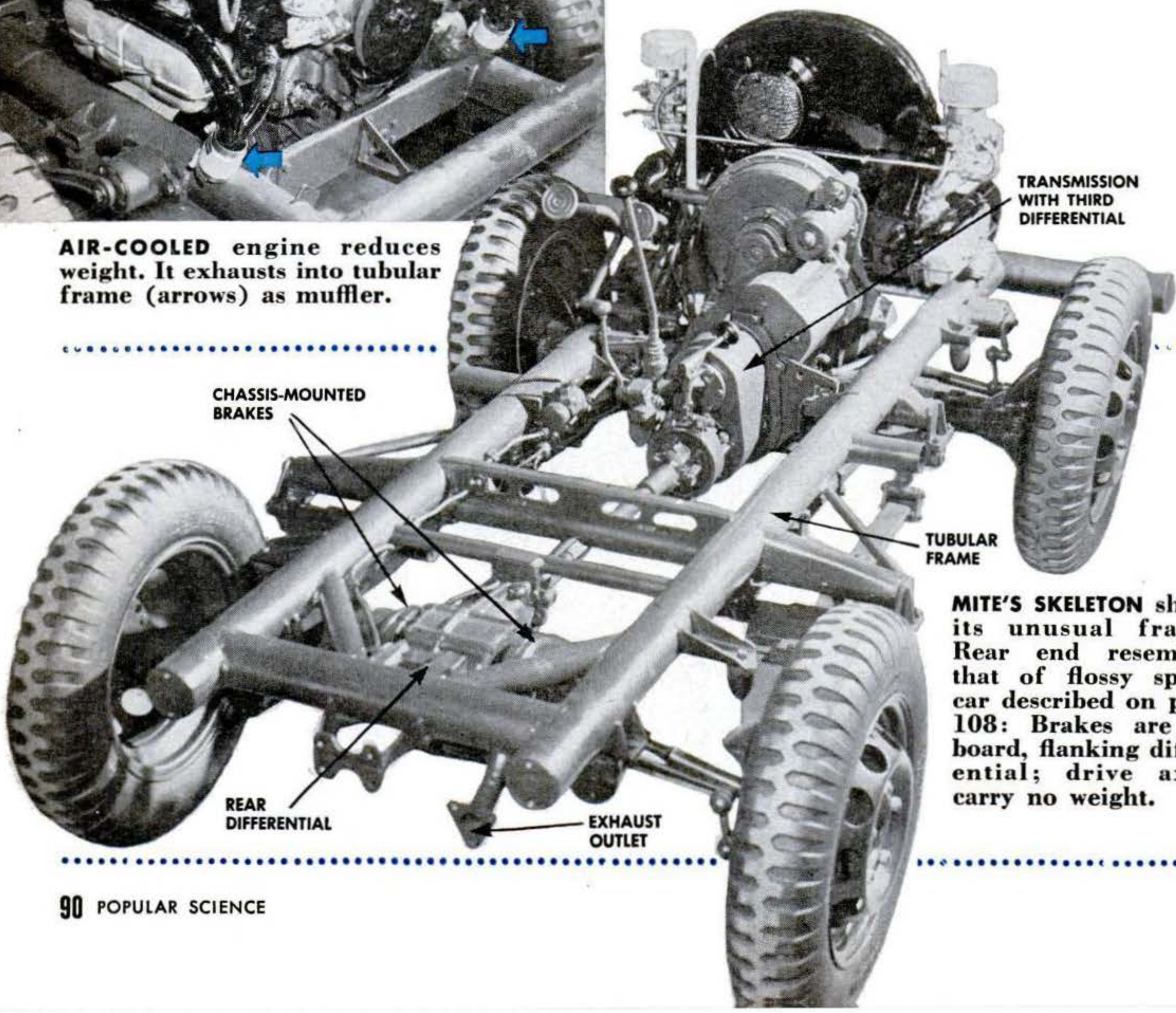
More Tricks to Come

"Now watch this," he said. His hands were off the wheel again. With one finger he spun the wheel sharply to the right. I braced myself. The car turned slightly to the right, but straightened itself out almost immediately.

"That's just to reassure you for what's to come," Ben said. "You see, left to



AIR-COOLED engine reduces weight. It exhausts into tubular frame (arrows) as muffler.



MITE'S SKELETON shows its unusual frame. Rear end resembles that of flossy sports car described on page 108: Brakes are inboard, flanking differential; drive axles carry no weight.

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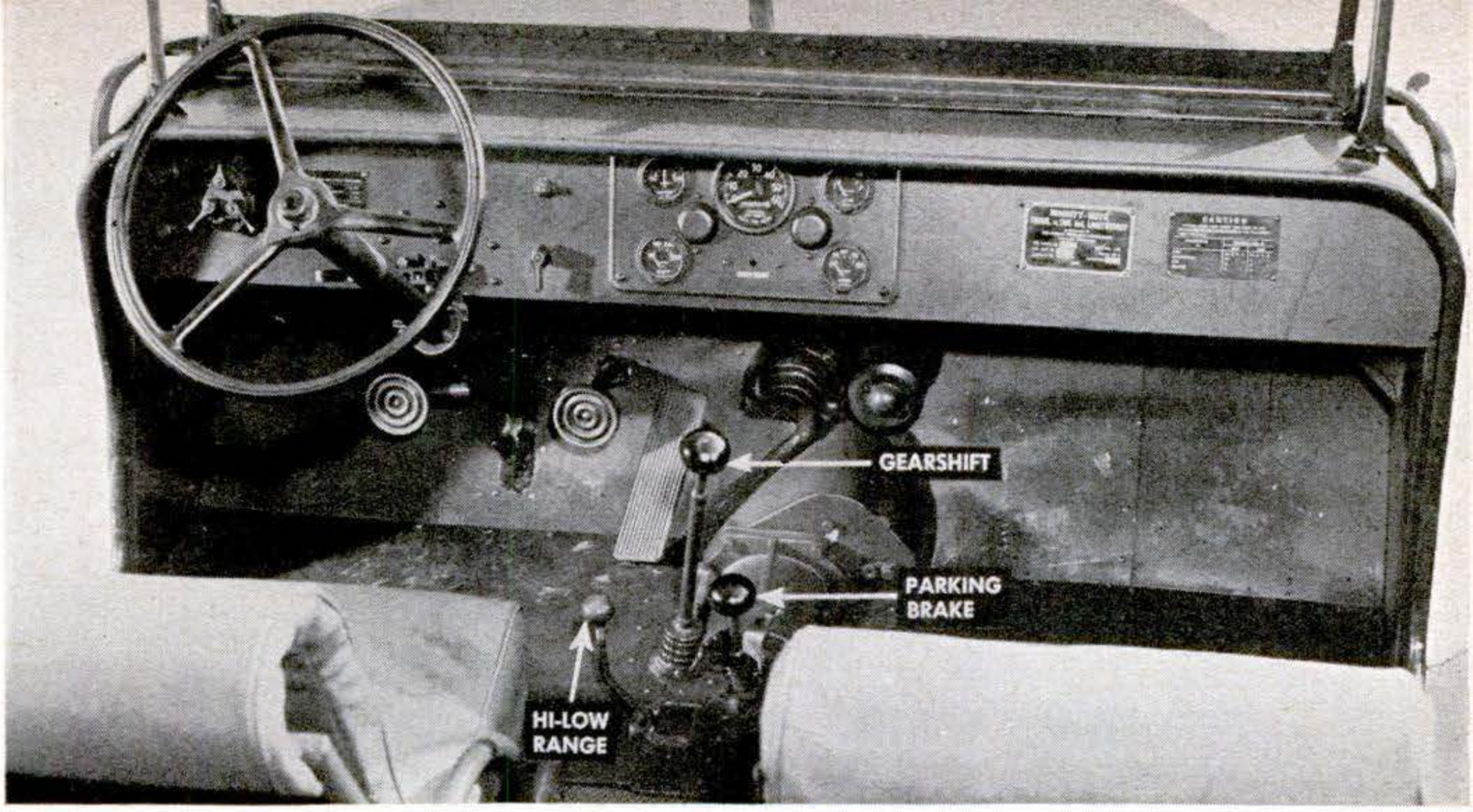

WHAT THE DRIVER SEES. For compact stacking in transport plane, car reduces to 45-inch height. Seats and windshield fold back, steering column lowers onto cushion.

themselves, those front wheels just want to go straight ahead."

Then the tricks came fast. Through king-size potholes, over a rough and rutted shoulder, then down into an eight-inch-deep drainage ditch between the road shoulder and a sharp climbing embankment. Up on the embankment and then straddling the ditch—all with one-finger steering. And over the roughest of it I felt none of the tail-bone shocks you get in a jeep.

We approached a wide part of the road. Gregory slowed down, but we still made a U-turn at a good clip.

"That," he said, "was to show you that the Mighty Mite has four-wheel drive at all times—even on sharp turns on smooth pavement."

"What's the gimmick?" I asked.

"A third differential, in the transmission, between the front and rear differentials," he explained. "It prevents wrap-up by compensating for the different distances the front and rear wheels have to travel in taking a curve."

Now there was a steep embankment on our right going down about 15 feet.

"That's an 85 percent grade," he said. "We've measured it."

Before I could ask why, I got the answer. We were going down it, slowly. At

FACTS ON THE MIGHTY MITE

Model: utility truck, ¼-ton lightweight; four-passenger (two on seats, two on rear fenders).

Engine: air-cooled, 4-cyl., 79 cu. in., horizontally opposed, overhead valve; 44 hp. at 4,000 r.p.m.; twin carburetion.

Weight: 1,496 lb.; per hp. 34 lb.

Transmission: three-speed forward in Hi-Lo range, with No-spin differential; positive four-wheel drive at all times.

Brakes: four-wheel, chassis-mounted, conventional two-shoe hydraulic with built-in self-adjusting features; sealed against water and dirt.

Electrical system: 24-volt, 1 battery.

Radius of turning circle: 12½′.

Springs: cantilever leaf, front and rear; each wheel independently sprung and suspended.

Ground clearance: 9¼″.

Dimensions: height, 58″; over-all length, 96″; width, 58″; wheelbase, 64″.

Adjustment: 3″ in steering column to suit size of driver.

Body construction: front fenders, hood, cowl and side panels, 16-gauge aluminum sheet; cargo body and rear fenders, 20-gauge steel, rigidized for strength.

Tires: 5.90 by 15, cross-country, 4-ply.

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BUILT-IN BALANCE, fore and aft as well as side to side, enables Mighty Mite to run on any three wheels. In an emergency, a wheel can be changed without using a jack.

the bottom he braked to a stop. The car was standing almost straight up on its nose.

"Let me see you get out of this," I challenged.

Gregory shifted into low speed, Lo range. (The Mighty Mite has three speeds forward, which, with Hi and Lo ranges, makes six.) There was a grinding of power. A slight shuddering and the front wheels pulled us out onto the level ground. We were off again.

Off again was right. This was the Mid-America's proving ground—a driving nightmare of trenches, ridges, humps, bumps, crisscross gullies and deep hog wallows. Up and down we went, leaping into the air, leaning over at fantastic angles. As we nosed down into a mudhole the right rear wheel shot up into the air. Next only the front left and the right rear wheel were touching ground.

No-Spin Differential Does It

Gregory realized that these wheels-dangling-in-air antics puzzled me. "Only the wheels that have traction get power—all the power," he explained. "No-spin differential, you know."

Back at the plant, there came another believe-it-or-not demonstration. A mechanic removed the right rear wheel. The Mighty Mite didn't flop down on its wheelless hub. A driver got in and took off. Fast, slow, in tight circles, it didn't make any difference. The wheelless corner stayed up.

Car's Performance Explained

The mystery of this performance was explained by Herbert A. Blenkle, chief engineer.

It is a matter of balance. The vehicle is designed so that its center of gravity is at the intersection of lines drawn diagonally from opposite wheels. Removing one wheel doesn't move the center of gravity enough to throw the car off balance.

There is also what Blenkle calls "pivot-center steering." Because the pivot, inside the hub, is directly in line with the wheel, as in a bicycle, the wheel always wants to go straight ahead. As in a bike, there is no twisting tendency when a wheel hits a bump. The result, as Blenkle explains it, is that the steering wheel doesn't have to fight the road. The scheme, he says, gives the feel of power steering without auxiliary power to do the work.

Independent suspension of each wheel

[Continued on page 278]

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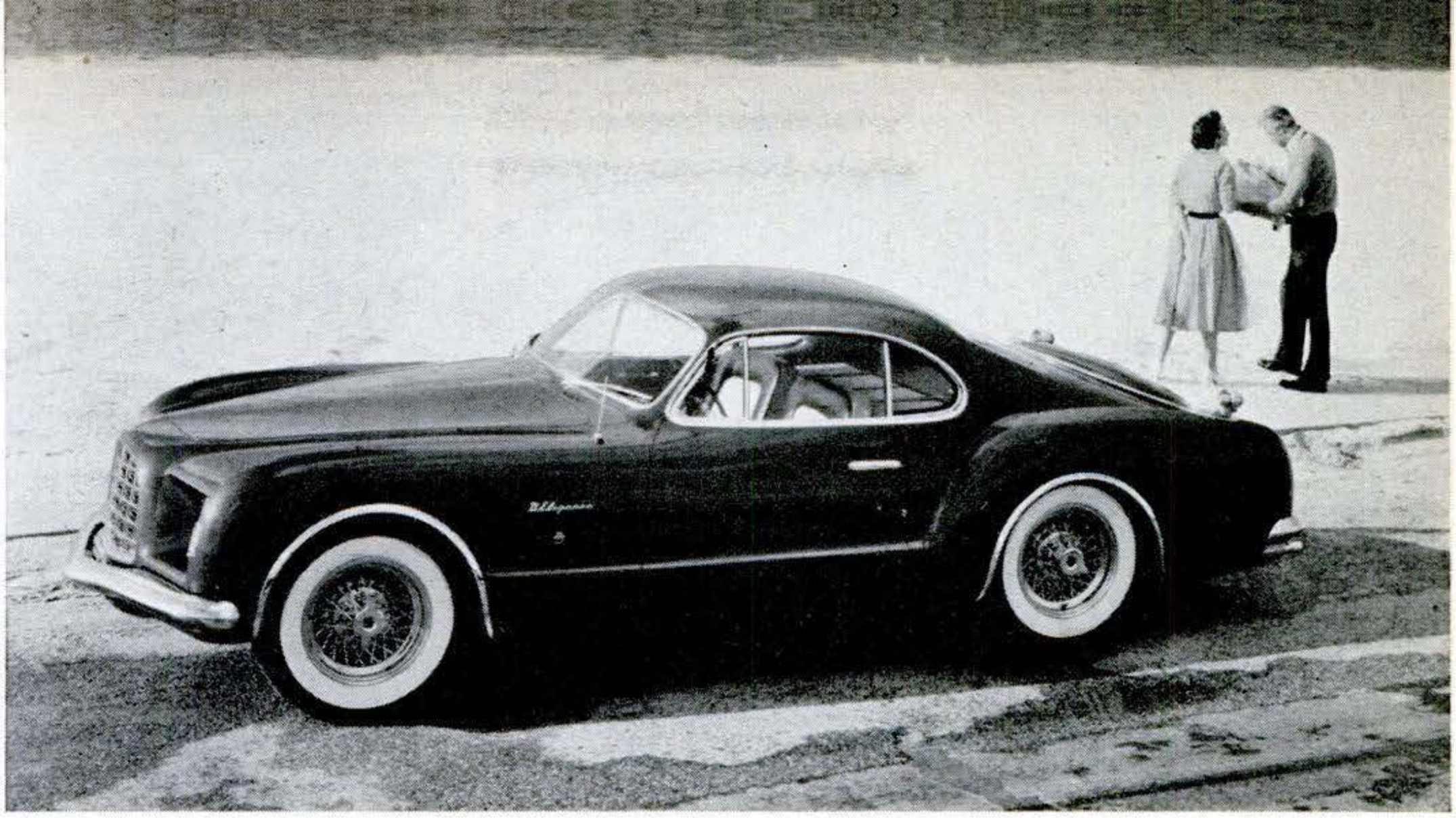
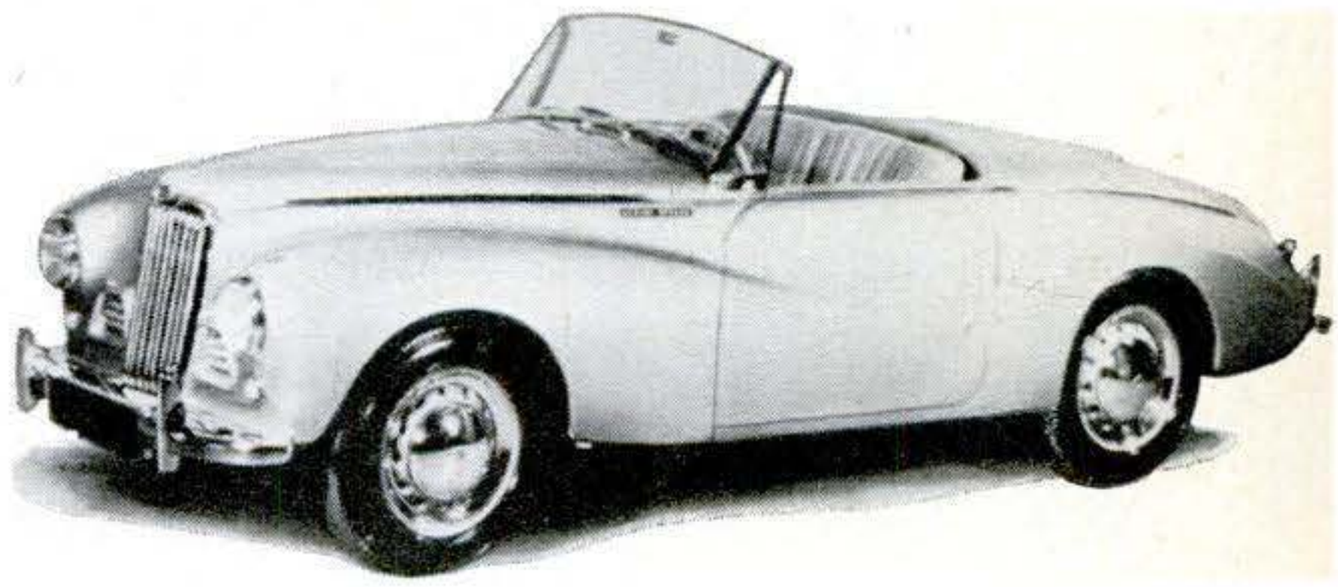


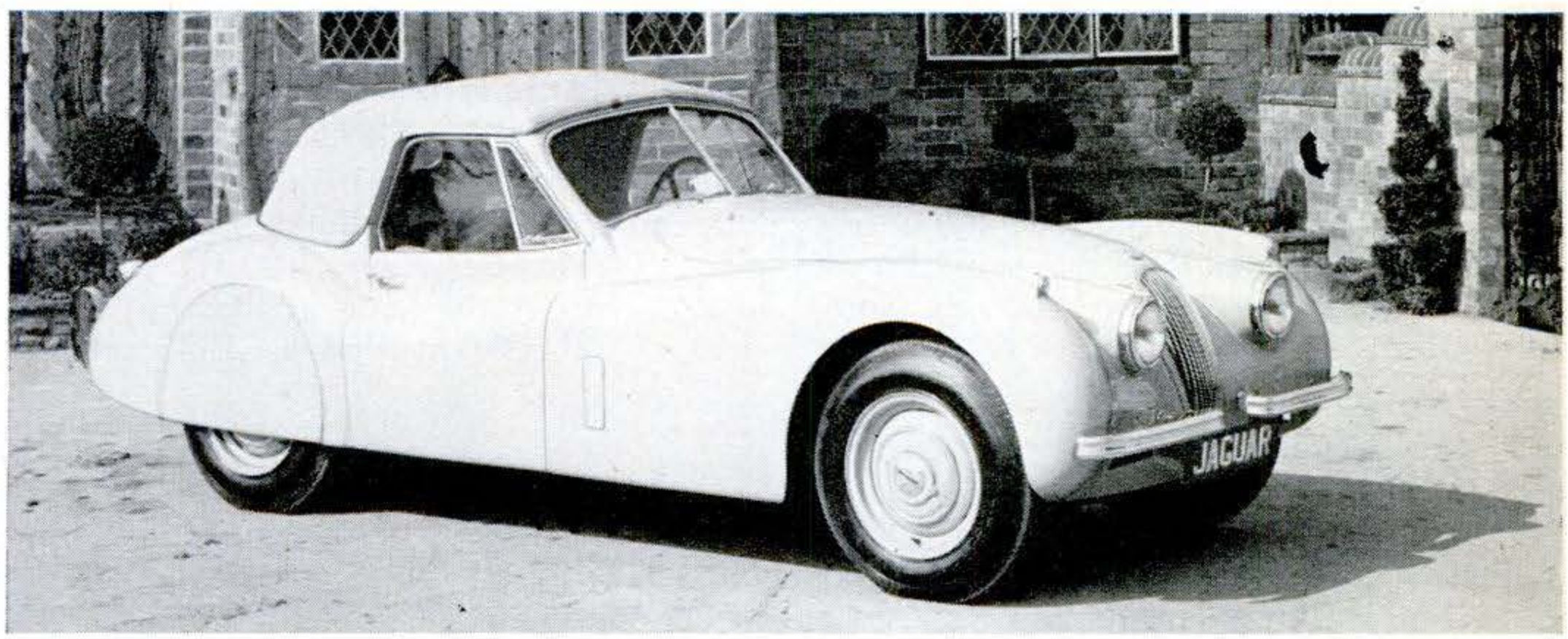
Chrysler Builds Dream Sports Car on Modified Chassis

THE newest Chrysler "idea" car—"idea" means that you can't buy one—is the D'Elegance. A two-seater sports convertible, it has the FirePower V-8 engine and a New Yorker chassis trimmed 10½ inches to 115½. The body is Italian. The spare tire is hydraulically lifted from a rear-deck well. Matched luggage is fitted behind the seat.

Sunbeam's Alpine Car Strips for Road Racing

A 120-M.P.H. competition sports car, the Alpine, has been added to the English Sunbeam line. A two-seater, it can be stripped of top, windows, and hood louvers for racing. The four-cylinder 80-hp. engine displaces 138.2 cu. in. The Alpine costs $2,999 in New York; specially tuned, about $350 more.





Jaguar Converts Sports Racer to Slick Convertible

THE Jaguar XK-120 is a 149-m.p.h. hot-shot in competition but a little on the wind-blown side as transportation. Now Jaguar has made a sister convertible by adding a folding top and drop windows. It's said to make around 133 m.p.h., which ought to be fast enough for anyone just taking his girl for a spin. The car sells for $4,250, N. Y.

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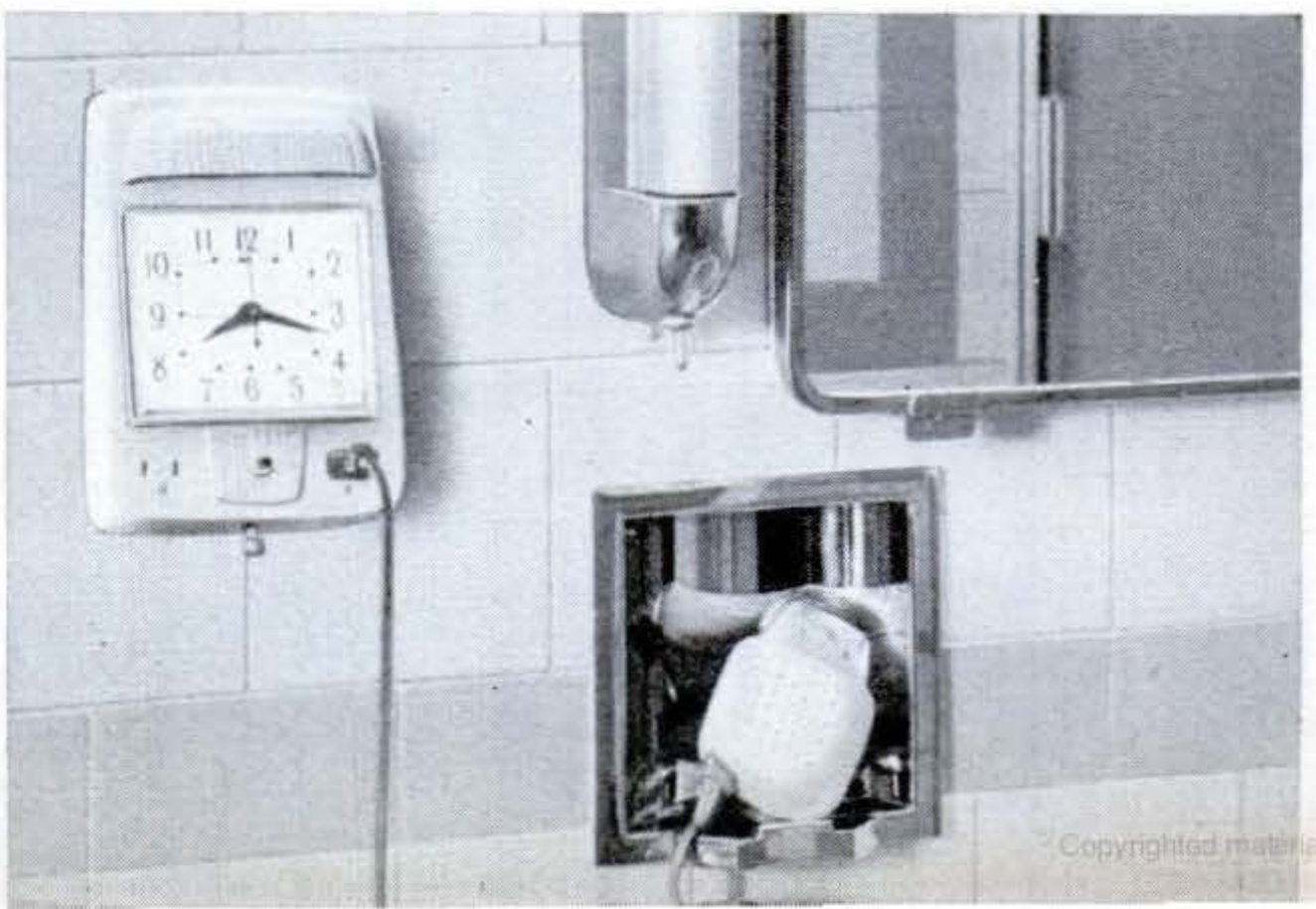
Helmet Protects Ball Players

ALFRED GRUNWALD, rookie first baseman for the Pittsburgh Pirates, is shown below holding a plastic cap (right) which is being used for the first time this year. Previously, a liner was inserted in the cloth cap (left) when a man went to bat.

Wall Clock Handles Three Jobs

THIS clock is a part of the house—it is built in over a standard four-inch wall box and carries two outlets for plugging in appliances (like the razor shown). A night light fits under the hood at the top of the clock. It's the Tel-in-Wall, a GE Telechron.



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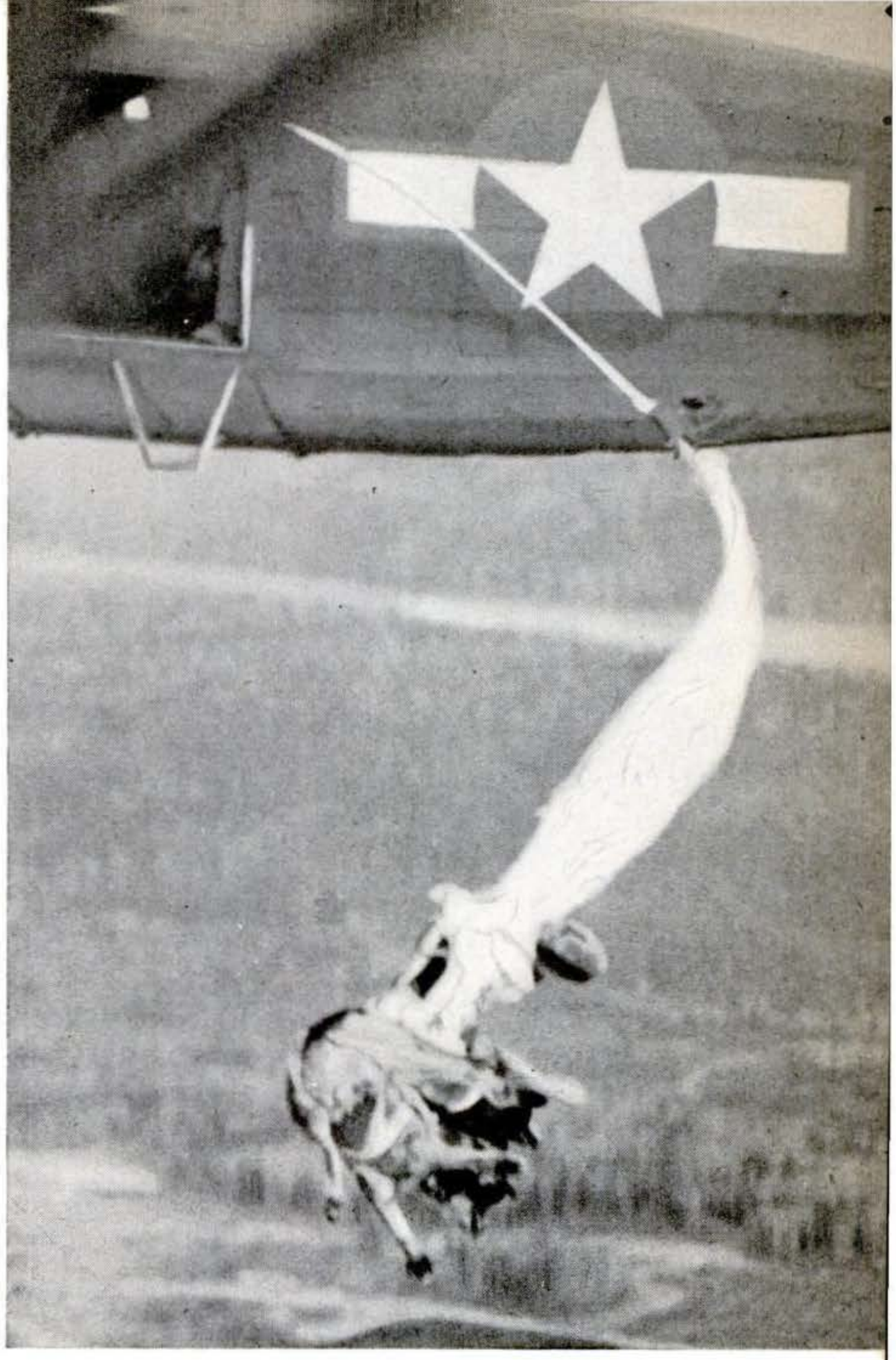
Army Dogs Drop by Chute to Rescue Fliers



AFTER training for weeks on ropes strung across a ravine, the Alaskan huskies at left wait at the door of a moving plane to make their first jump. At right, they are in the air—full-fledged para-pups. A new type of war dog, they will work with the Air Transport Service, searching out downed fliers in inaccessible areas.

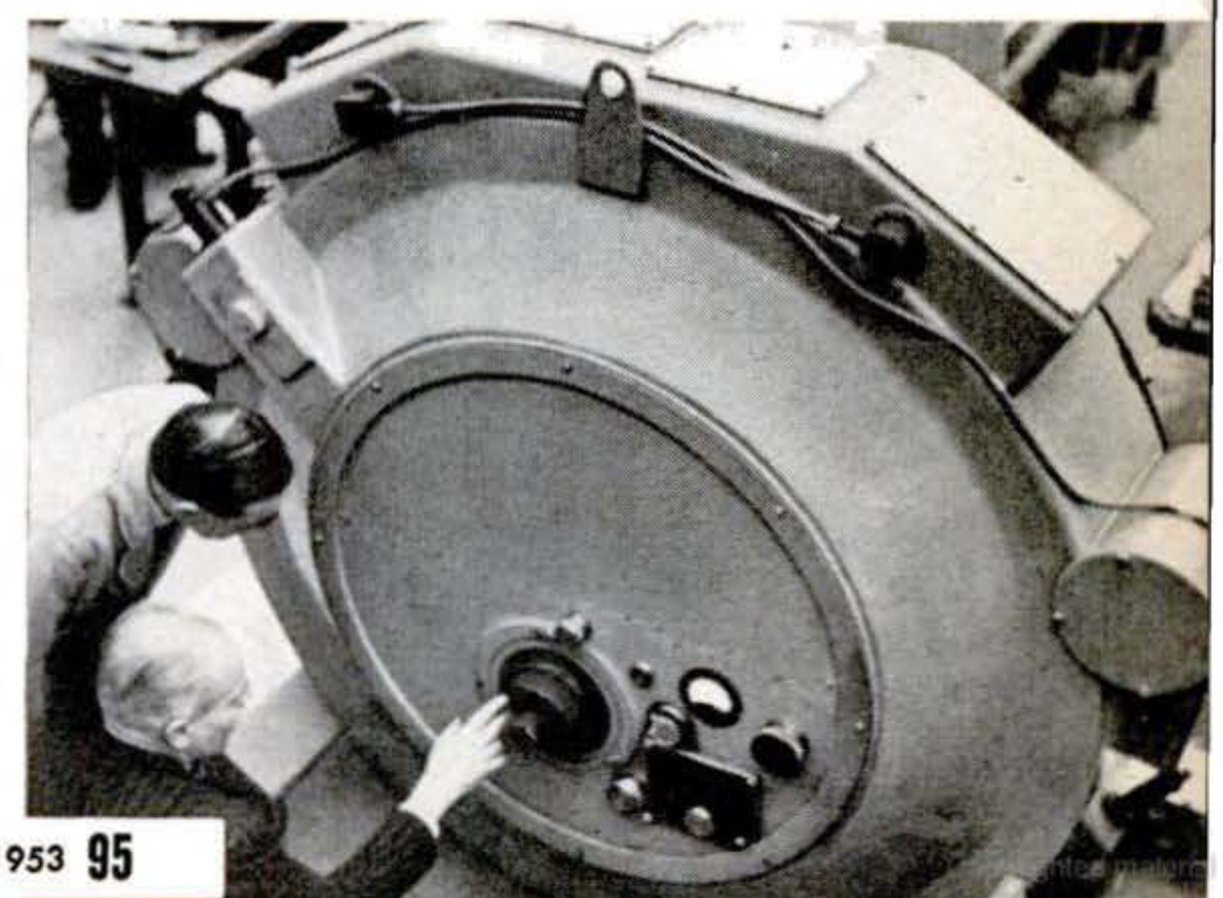
Other huskies in the K-9 Corps haul sleds in Alaska. In Korea, Dobermans, giant schnauzers, shepherds and collies have served as sentries, scouts and messengers. One man and three dogs make a team for sentry work and guard duty in Japan and Germany. Sentry dogs can earn a diploma in only eight weeks at one of four training camps for "Wags."

Back-Yard Pool Costs $100

A PLASTIC pool that sells for about $100 moves the old swimmin' hole right into the back yard. Large enough for shallow diving, it is 12 feet in diameter and 24 inches deep when fitted over the rigid stand. Doughboy Industries, New Richmond, Wis., makes it.

Camera Shoots 50,000 a Second

THIS high-speed, drum-type camera snaps 50,000 pictures on 10 feet of film every second. It holds the 35 mm. film stationary while the optical works spin. The British Admiralty's research lab developed it for use in scientific research.



Can We Tame

Putting man-made sun fire to peaceful uses may become the greatest feat of atomic science.

By Alden P. Armagnac

IN a darkened laboratory at the University of Lyon, France, experiments have been in progress that may shake the world.

Here two atomic scientists, J. Thibaud and D. Perrier, have been setting off tiny explosions in glass and plastic vessels about the size of a drinking tumbler. Heated to incandescence by the shock wave of an explosion, air or argon gas in the vessel momentarily becomes luminous. Cameras register its bright glow. For a fleeting instant, the experimenters estimate, the temperature within the vessel surpasses that of the sun's surface.

Though their apparatus is small, their aim is spectacular. What the experimenters are seeking, they have announced, is a safe and controllable way to touch off a thermonuclear atomic reaction—the awesome reaction of the hydrogen bomb! If they should succeed, it would mean that the H-bomb's power could be tamed and harnessed for peaceful uses.

Hitherto this has been thought impossible. A temperature of millions of degrees is generally held necessary to touch off the H-bomb's reaction, in which speeding cores of hydrogen atoms collide and fuse together, turning into helium and liberating enormous energy. The interior of the sun, which owes its

Mighty blast of A-bomb has been only way known to set off H-bomb's reaction.

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the H-Bomb?

heat to a thermonuclear reaction, has such a temperature. To match it on earth, only one way has been known—exploding an A-bomb. So, whatever an H-reaction's scale, the havoc wrought by its A-bomb detonator has seemed to rule out any but military uses.

If a less violent "trigger" could be found, it would be a different story. For a thermonuclear reaction can be of any size whatever—large or small. At the opposite end of the scale from super-colossal explosions, it could yield "atomic firecrackers"!

Thus the way would be opened to put the H-reaction to work for the good of mankind—to raze unwanted mountains, dig great canals, and stoke mighty engines, instead of serving only in instruments of fiery death and ruin.

H-Power Rumors Fly

Secret work toward this goal, as hush-hush as that which seems to have produced a successful H-bomb, has been hinted before.

Argentina's president announced in 1951 that "thermonuclear reactions," mysteriously produced in a Heumel Island pilot plant by Dr. Donald Richter, Austrian-born scientist, would yield atomic power for industry. Then, last year, news dispatches said the project had been abandoned and its 300 pilot-plant workers dismissed.

Whether Dr. Richter's claims belong with famous hoaxes of history, or a bona fide scheme met with unexpected tech-

Luminous glow of gas hit by shock wave may lead to a new and gentler way.

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nical difficulties, may never be known.

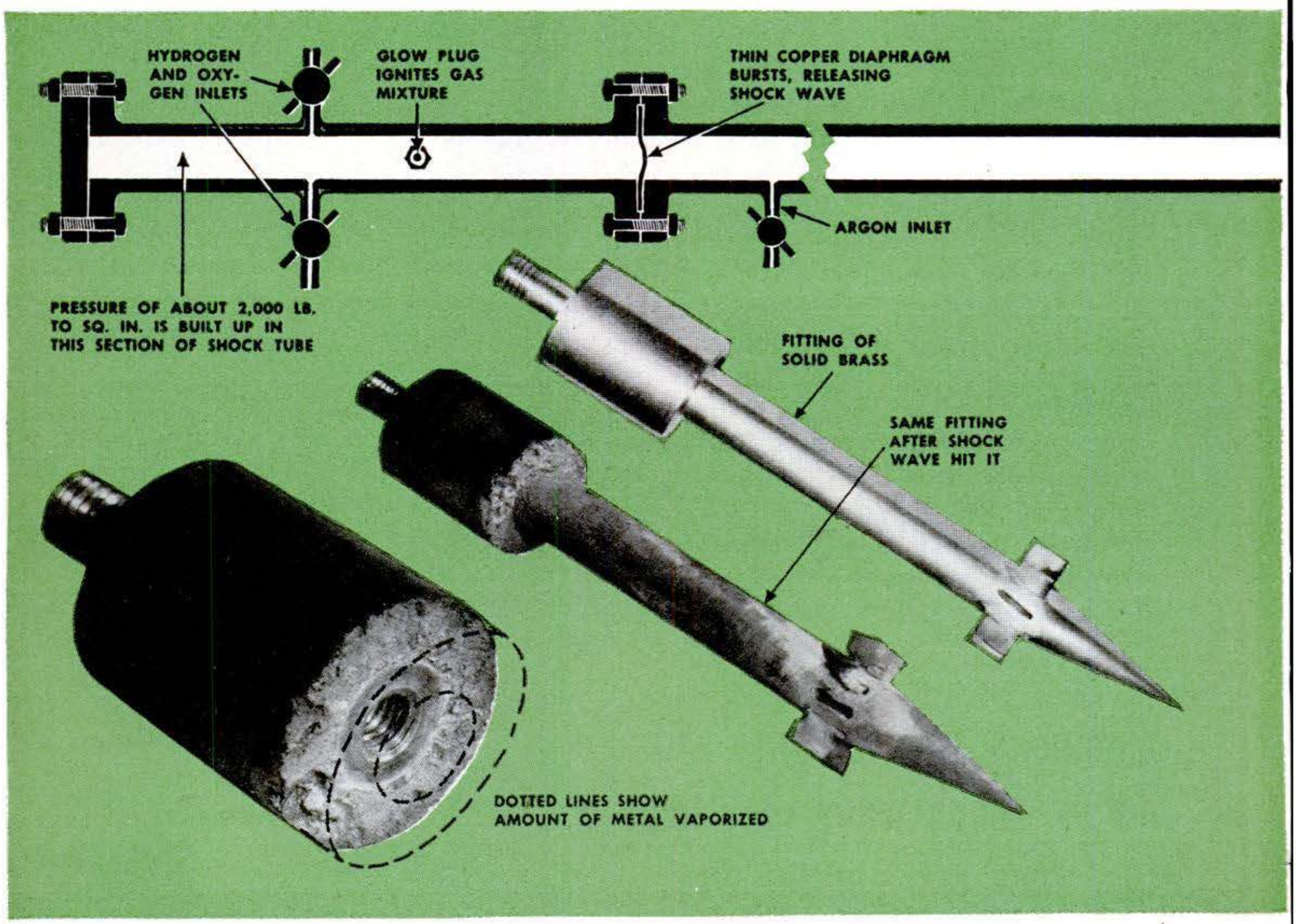
Nearer home a Washington news agency, "Science Service," reported last summer that U. S. Atomic Energy Commission scientists were working on taming the H-bomb reaction for peaceful uses. On paper, it said, they believed they had found a gentle way to "trigger" it; laboratory trials were to follow. Discussions reportedly were going on, "both within the AEC and on Capitol Hill," as to when to make public this sensational development. To date, however, neither details nor any official confirmation of this report have been forthcoming.

So any proposed "tame" way to touch off a thermonuclear reaction would remain a total mystery—but for a clue indirectly furnished by the AEC itself. Twice monthly it issues a digest of atomic-science articles from technical journals all over the world. Thus comes to light a little-known report by Thibaud and Perrier, written in French and printed some time ago in the Italian physics journal *Il Nuovo Cimento*, telling of their remarkable tests with shock waves.

Scientists long have known, they point out first, that shock waves can make gases luminous. When earlier French experimenters set off pellets of flameless explosive, within a hole bored in a vertical brass cylinder, glowing plumes emerged and were photographed. (See drawing based on photo, on page 97.)

To make a gas incandescent, shock waves must raise it to an extremely high temperature—so Thibaud and Perrier were struck with the possibility of kindling an H-reaction with shock waves' heat. Their experiments sought the most promising approach.

Explosive "shaped charges" like those of armor-piercing military rockets, but scaled down to half the size of a thimble, gave the best results. The experimenters obtained especially brilliant flashes of light when they aimed two or more



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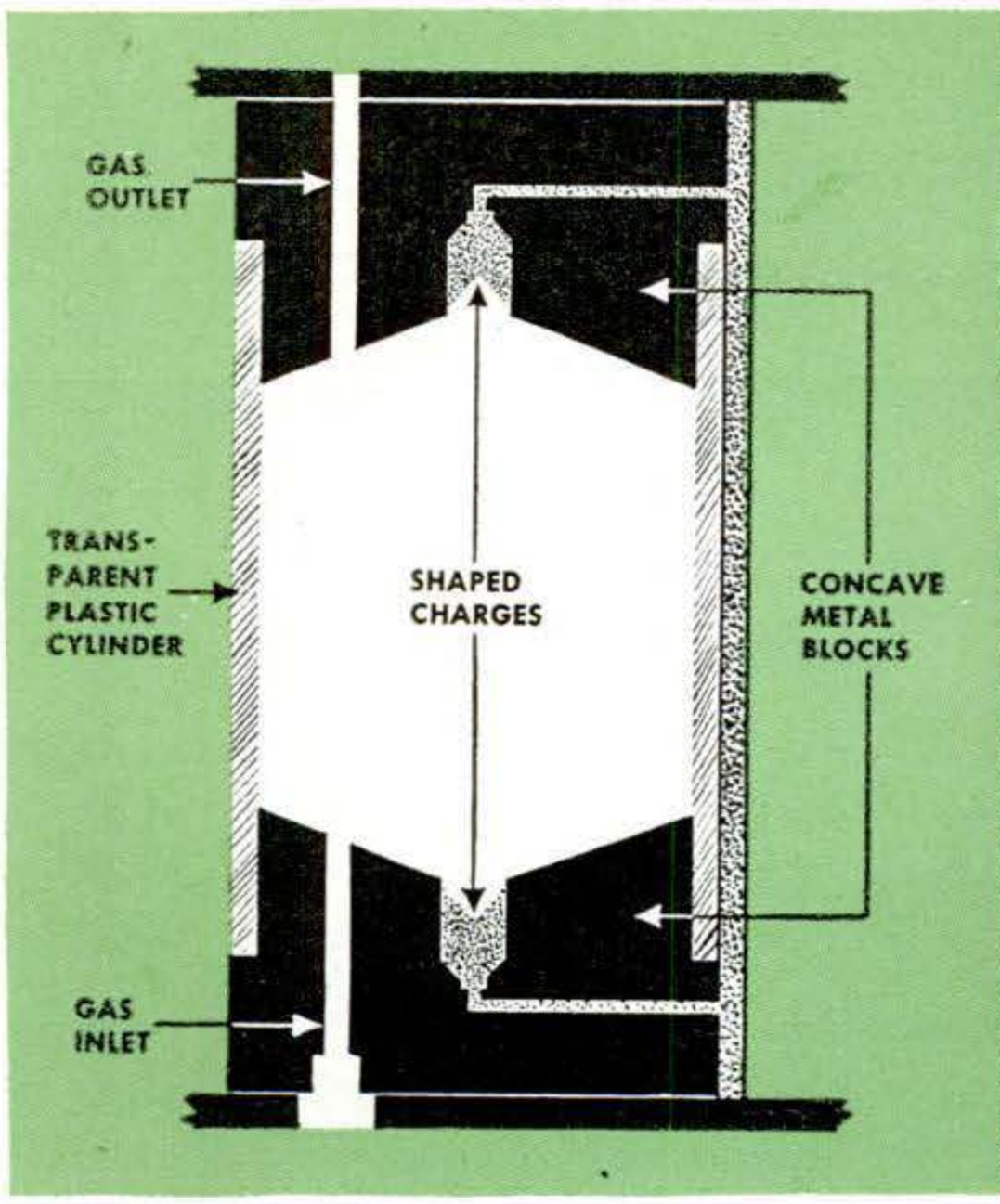
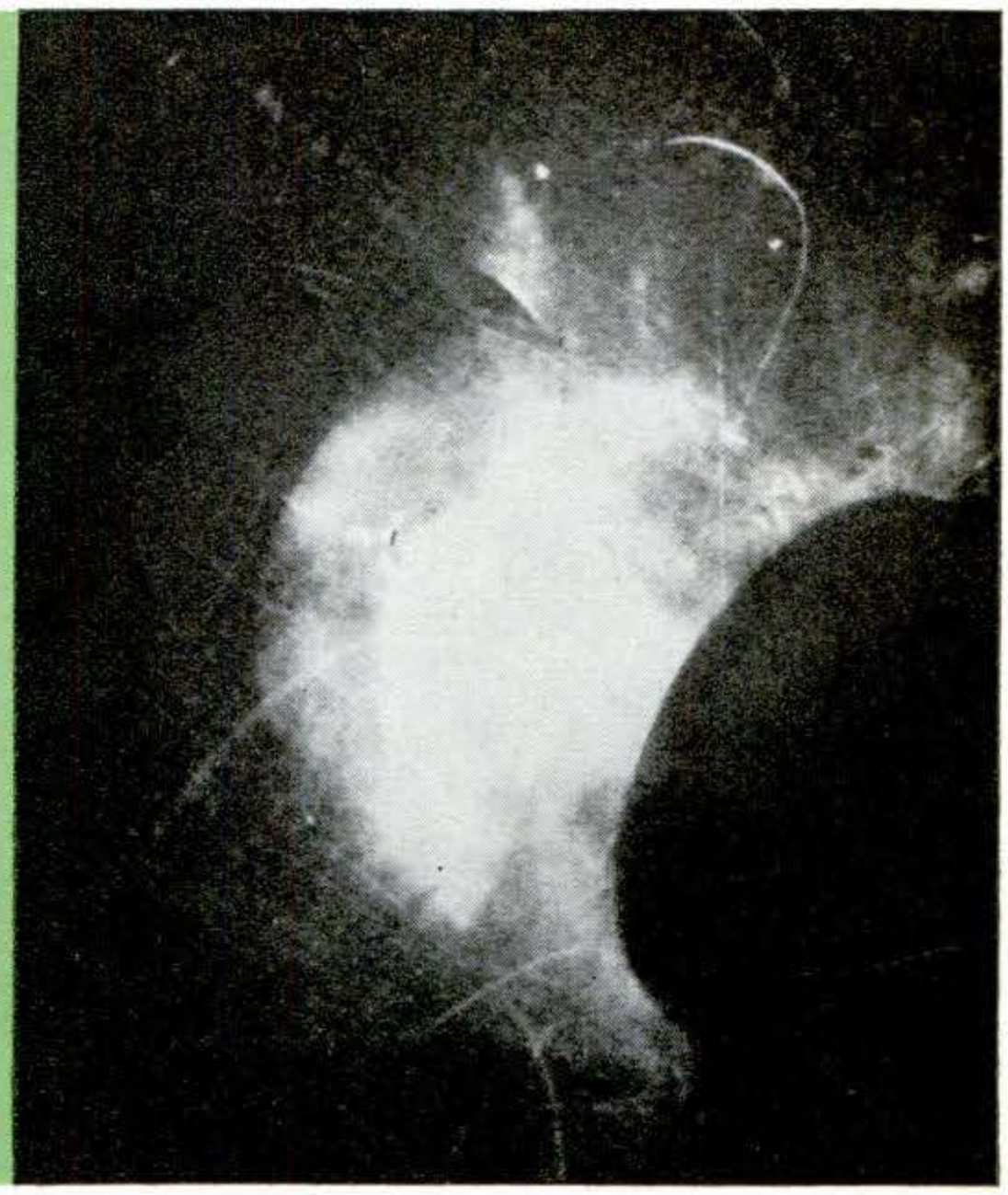
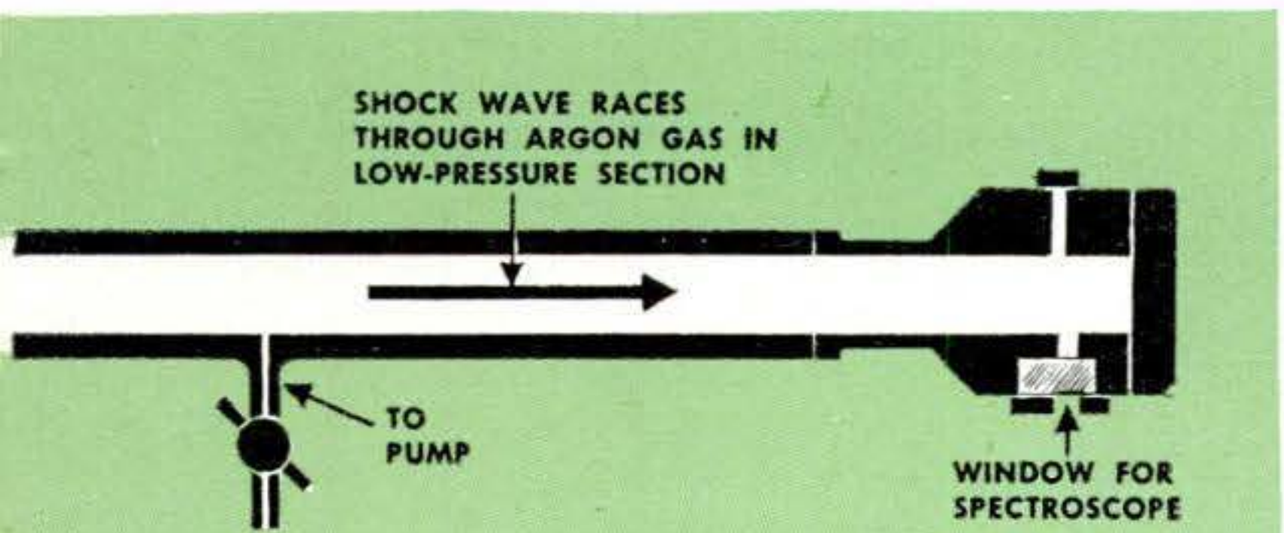


SCHEMES TO SET OFF H-reaction are tested by midget shock-wave apparatus, one of several used by Thibaud and Perrier. Shaped charges face each other. Shock waves' collision gives temperature of tens of thousands of degrees.



BRILLIANT FLASH OF LIGHT occurs, as shock waves' collision momentarily makes argon gas incandescent. In this test, apparatus at left was placed horizontally, and camera aimed obliquely. (Photo from *Il Nuovo Cimento.)*



SHOCK-WAVE experiments in the U.S. are illustrated by this eight-foot "shock tube" of steel, developed for guided-missile studies by Dr. Arthur Kantrowitz at Cornell. Admitting hydrogen gas from high-pressure cylinder, or exploding hydrogen-oxygen mixture, bursts thin metal diaphragm. Shock wave races through tube (from left to right in diagram). Gas in tube becomes incandescent, and temperature above 32,000 degrees F. has been reached.

Before-and-after photos show what happened (in modified setup of apparatus) when shock wave hit brass piece. Heat evaporated quarter-inch of solid metal in about 1/10,000th second.

shaped charges at each other, so that the shock waves collided.

Temperatures attained were estimated to be of tens of thousands of degrees, hotter than any furnace in the world, and exceeding even the 10,700-degree temperature of the surface of the sun.

The experimenters propose two ways to go still higher and, perhaps, reach the fantastic temperature it takes to start an H-reaction. One is to use more and bigger shaped charges. The other is more novel. High-voltage electrodes would accelerate the dense clouds of ions, or charged particles, produced when the shock waves collide. Giving already-speeding particles this added kick should be equivalent to boosting their temperature.

What Goes On Here?

Are rumors of a U.S.-developed trigger for the H-bomb based upon similar experiments? While that must be speculation, here are facts:

Experiments with powerful shock waves have been under way at the AEC's

[Continued on page 252]

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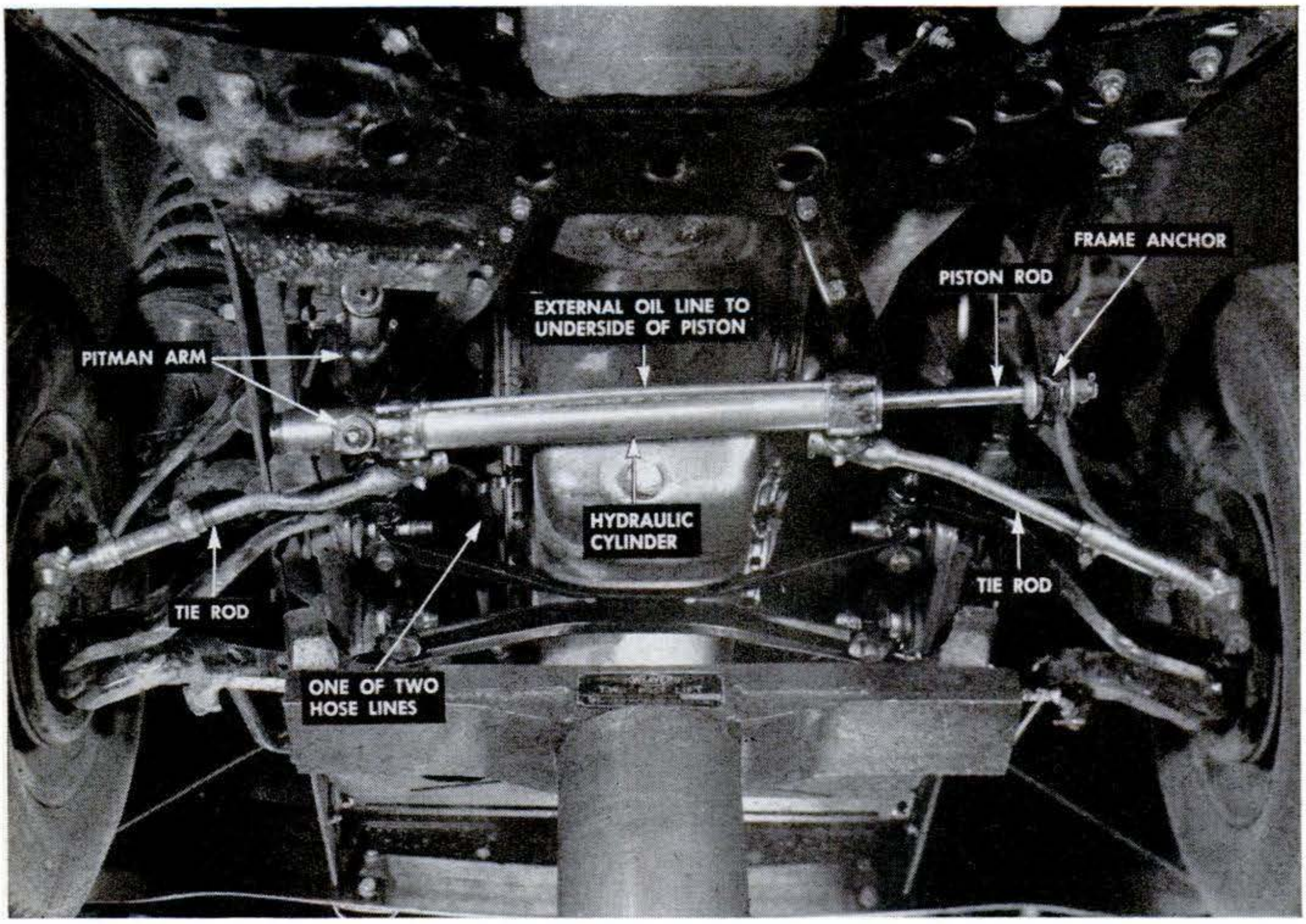
New Power Steering Fits Old Cars



SIMPLE AS CAN BE, the Monroe power-steering unit is shown here on a 1953 Nash. The unit was left unpainted, and the car's shock absorbers removed, for clarity's sake.

A POWER-STEERING unit recently put on the market can be installed eventually on any American car not older than a 1949 model.

Made by the Monroe Auto Equipment Co. of Monroe, Mich., the new unit is already being offered as optional equipment on new models by Nash, Willys and Kaiser. In the form of kits to be installed in about half a day by garage mechanics, it is available at present for 1949-53 Ford, Mercury, Buick, Cadillac, Oldsmobile and Packard cars, as well as for trucks and tractors.

Those kits cost from $225 to $250, and the average installation charge is around $25. Car owners are advised not to try to install the power-steering unit themselves unless they're set up to do a little welding.

The Monroe power-steering unit is a single tube containing the hydraulic cylinder and valve assembly. The tube is connected to the Pitman arm and to the two tie rods. In a typical installation, shown above, the piston is anchored to the car's frame on the right-hand side. Accordingly, the power-steering unit takes the place of the drag link in a conventional steering system. If the engine stops or the hydraulic system leaks, says Monroe, the worst that can happen to the car's steering is that it will revert to normal.

Two hoses carry oil from an engine-driven pump to and from the valve of the power-steering unit. One metal line carries oil to and from the underside of the piston.

The Pitman arm actuates the valve, and the unit can be adjusted so that as little as two pounds' manual pressure on the steering wheel, or as much as six or seven, will trigger the power boost. The driver has the feel of the road in his fingertips at all times, yet the hydraulic cushion provided by the power-steering unit eliminates most road shock.—*Wesley S. Griswold.*

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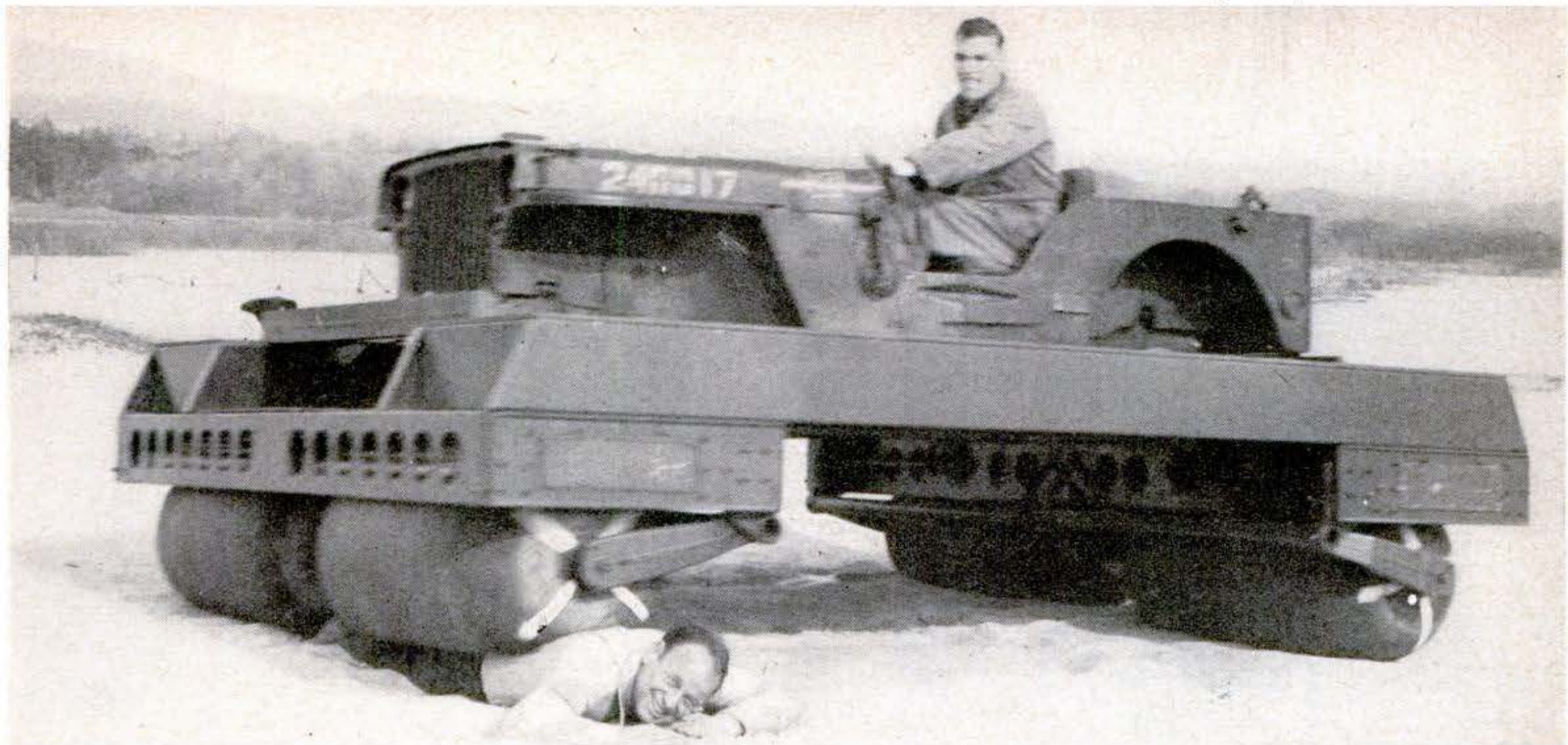
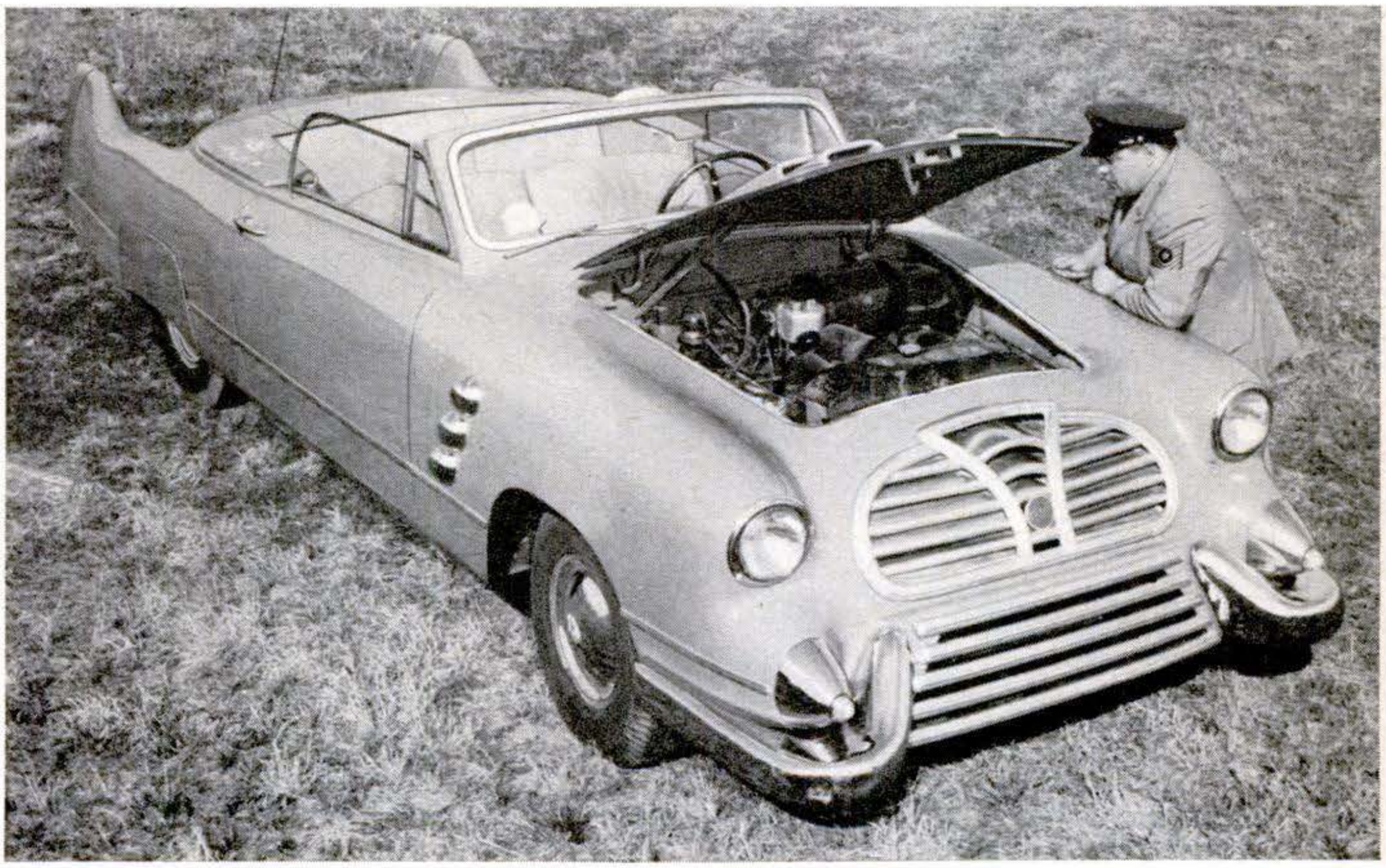


"Watermelon Tire" Runs Over Its Inventor, Leaves Him Grinning

HUGE, baggy tires on this specially mounted Jeep pack so little air that they "swallow up" obstacles instead of flattening them as shown by inventor William Albee (under a tire above). He says they will give vehicles better maneuverability over sand and swamp. Rollers on vehicle's undercarriage drive the tires; axles merely hold them in position. The Rolligon, molded by Goodyear, is now undergoing tests.

GI Designs His Own Dream Car: It Has Nine Rear Lights

M/SGT. LOUIS W. STRUNA, who designed this car himself, calls it four cars in one. The hood suggests an Alfa Romeo; the trunk is like that of GM's "dream car," Le Sabre; the headlight design was lifted from a comic book; and the engine came from a '49 Lincoln. There are nine rear lights—two tail lights, a turning light and a back-up light in each fender fin; a stop light at center. It was built at the Spohn works in Germany.



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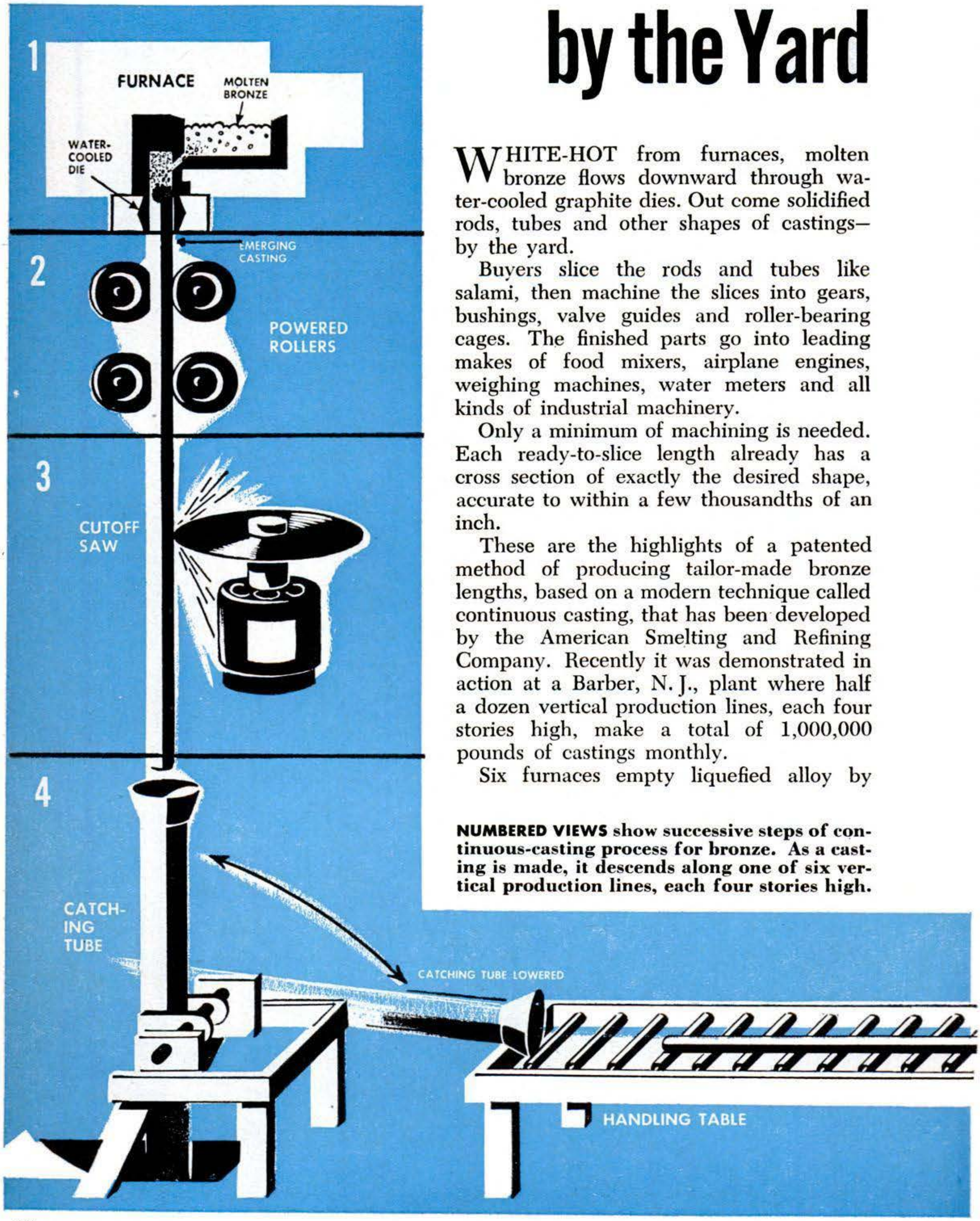
Gears and Bearings Now Made by the Yard



WHITE-HOT from furnaces, molten bronze flows downward through water-cooled graphite dies. Out come solidified rods, tubes and other shapes of castings—by the yard.

Buyers slice the rods and tubes like salami, then machine the slices into gears, bushings, valve guides and roller-bearing cages. The finished parts go into leading makes of food mixers, airplane engines, weighing machines, water meters and all kinds of industrial machinery.

Only a minimum of machining is needed. Each ready-to-slice length already has a cross section of exactly the desired shape, accurate to within a few thousandths of an inch.

These are the highlights of a patented method of producing tailor-made bronze lengths, based on a modern technique called continuous casting, that has been developed by the American Smelting and Refining Company. Recently it was demonstrated in action at a Barber, N. J., plant where half a dozen vertical production lines, each four stories high, make a total of 1,000,000 pounds of castings monthly.

Six furnaces empty liquefied alloy by

NUMBERED VIEWS show successive steps of continuous-casting process for bronze. As a casting is made, it descends along one of six vertical production lines, each four stories high.

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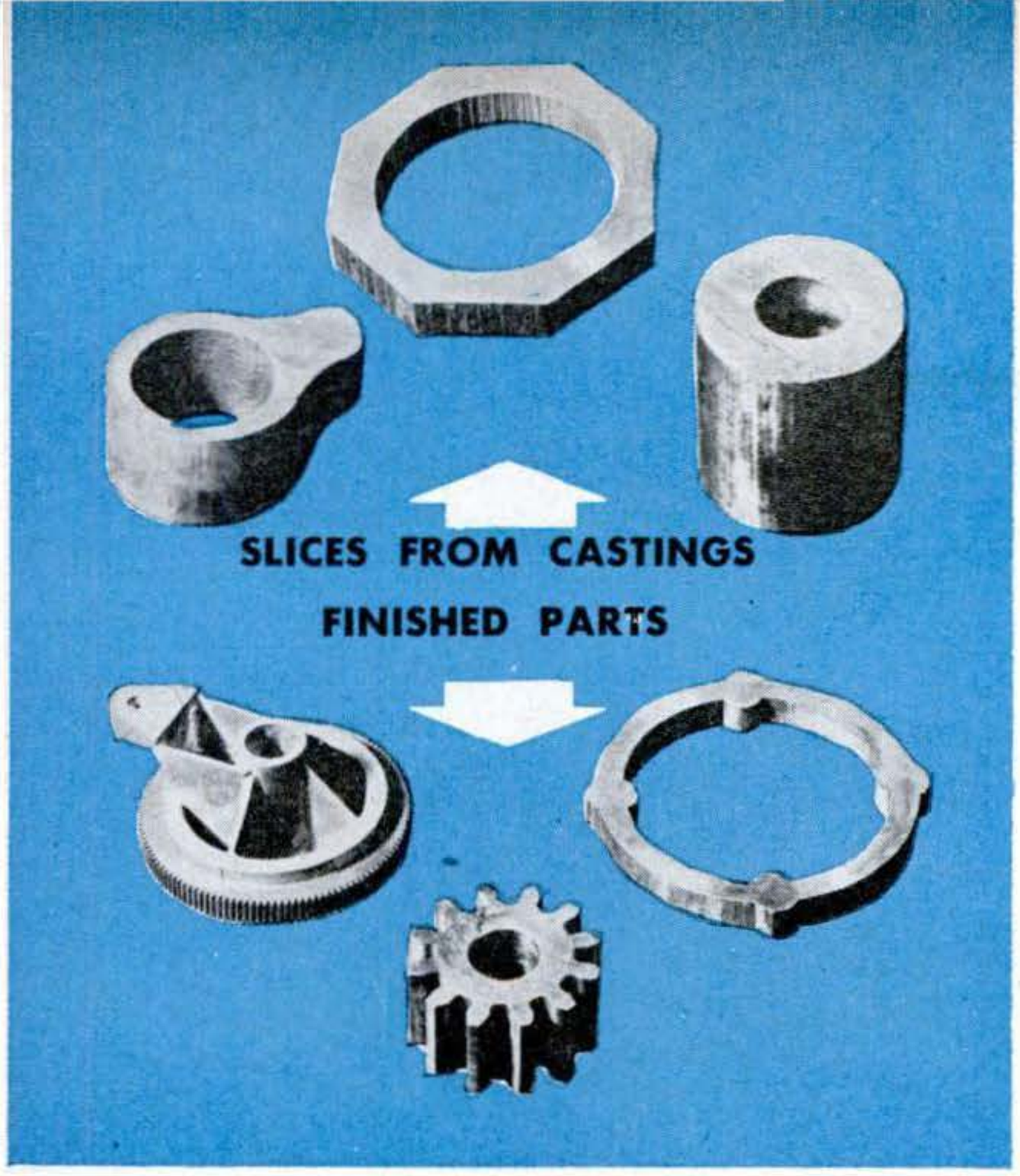
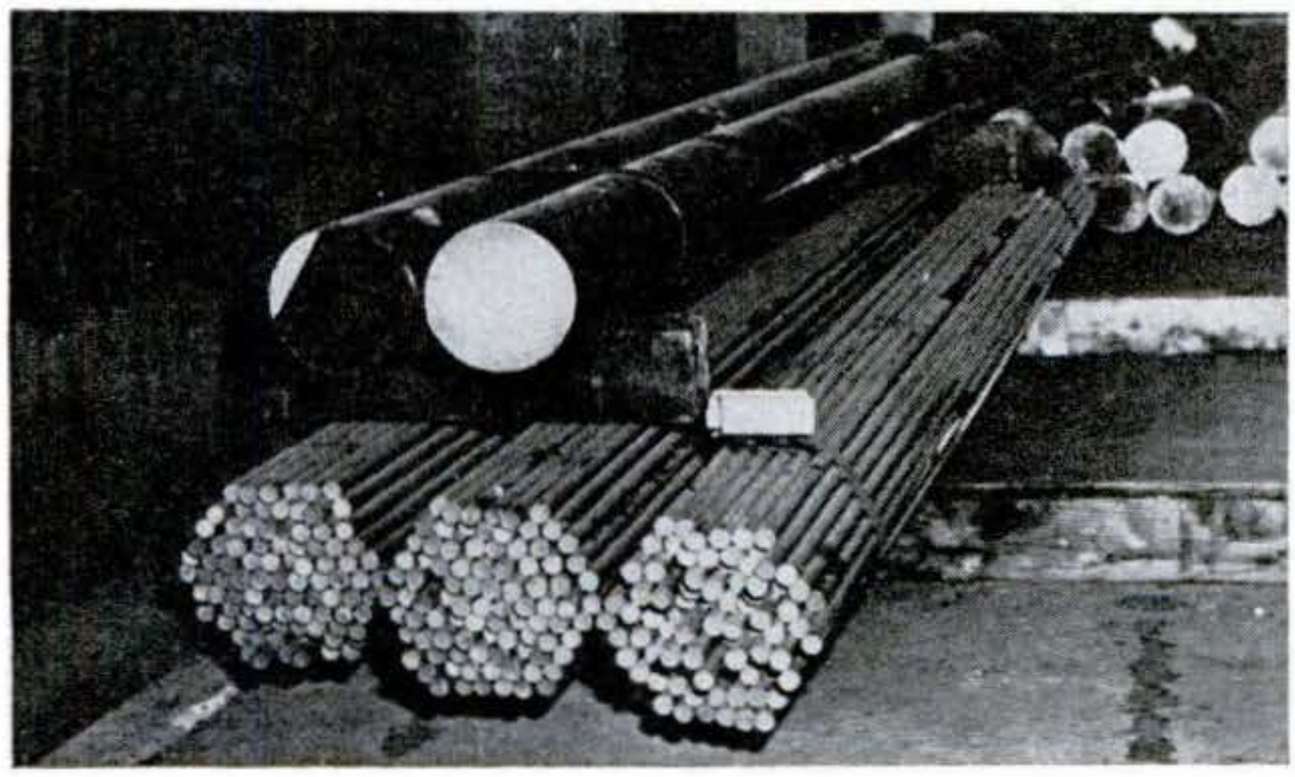


gravity into six dies. These determine the shape and thickness of castings, which may range from more than five-inch diameter down to curtain-rod slenderness. A die for small rods makes several at once.

Solidifying and emerging at the bottom of a die, a casting constantly grows in length. It passes between power-driven rollers, whose controlled speed governs its rate of descent. Finally an operator cuts off a desired length, up to 20 feet, with a swinging saw. The severed piece drops into a funnel-mouthed catcher, a tube that tilts to deposit it horizontally upon a roller-topped handling table.—*Alden P. Armagnac.*

BRONZE CASTINGS range in size from half-inch rods to massive 5⅛-inch bars. Color of metal is silvery, golden, or typical bronze, depending on proportions of alloy ingredients.



Vest Keeps Batteries Warm

EVER see a battery walking? Well, here's one—an electric vest. Its 117 pockets hold tiny interwired cells. Worn under an overcoat, the battery will be kept warm to power a walkie-talkie in subzero cold that would weaken the ordinary battery. Goodrich makes it for the Signal Corps.

Navy Tests New Missile

THE Navy's new Regulus, shown belching exhaust smoke to a ship's deck, can also be fired from a platform carried pickaback on a submarine. The 30-foot, jet-powered guided missile resembles a swept-wing jet fighter in appearance.

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What Airliner Are You Boarding?

IF YOU are a veteran air traveler you probably have boarded and flown in most of these planes. They are the principal types in use by the U.S. airlines today. Even if you are a groundling you no doubt have seen them being passenger-loaded on a Sunday afternoon visit to the airport.

The trick is to identify the planes from these views, limited pretty much to the doorways. Here are a few pointers: Are the windows square or round? Are there windows both fore and aft of the doorway? Is the doorway in the nose of the plane, in the middle or at the rear? Is the loading ramp built into the plane or the type that is rolled up to the plane? Don't try to guess by the name of the airline, for most of them use several types of planes.

This is a tough one, but that's all for hints. Now, under each photo write the type of plane you think it shows. Then turn to page 278 for the answers.

1 _____

2 _____

4 _____

5 _____

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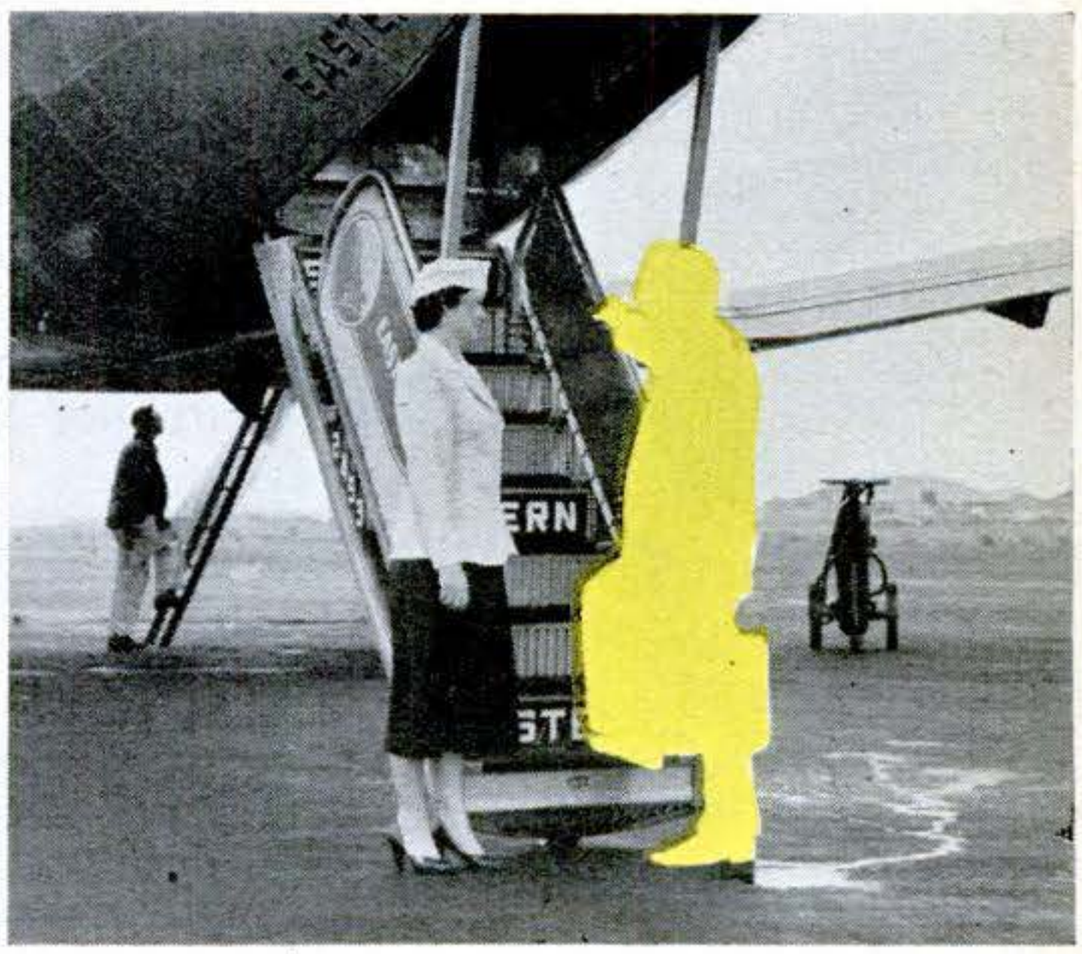
FLAGSHIP SAN DIEGO

AMERICAN

3

6



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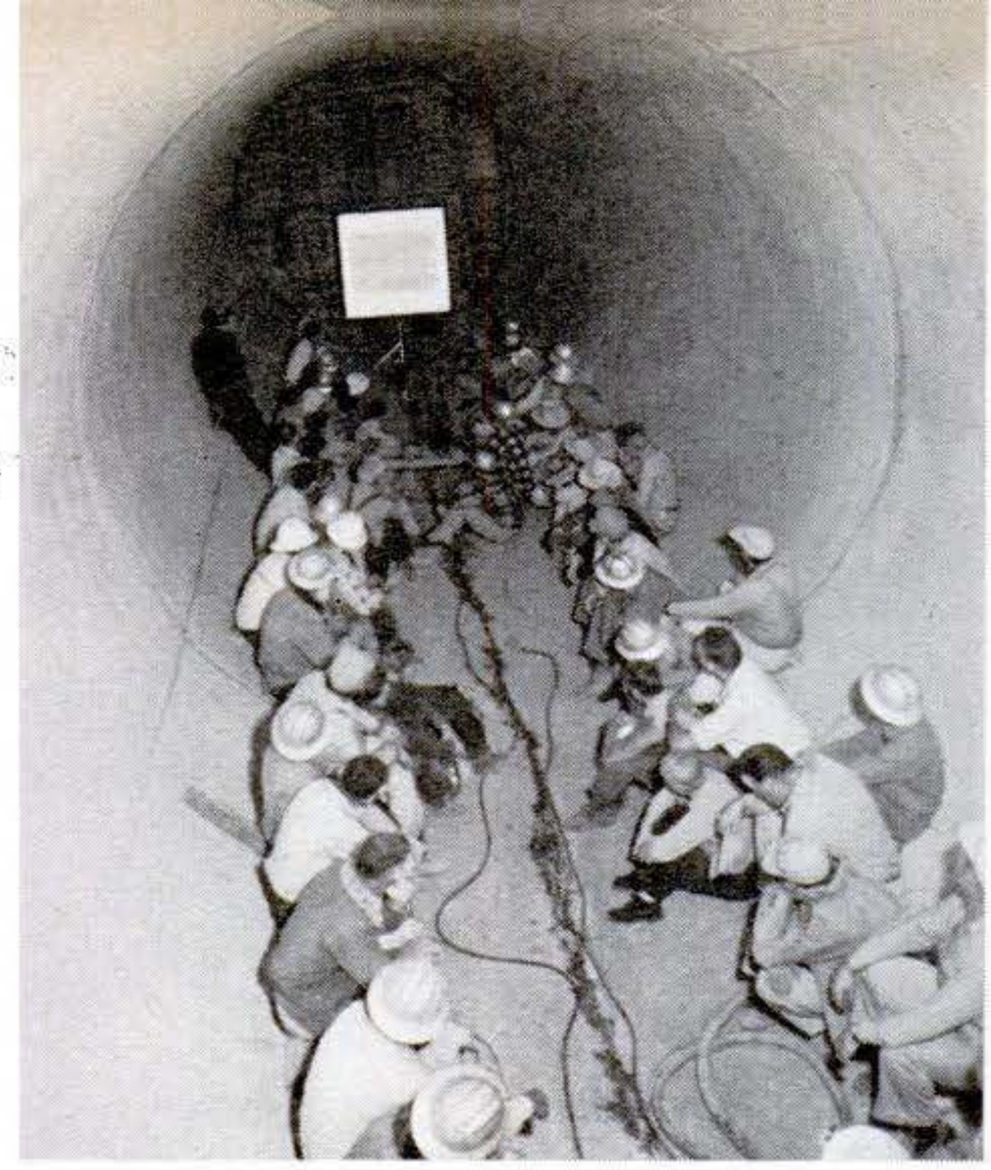
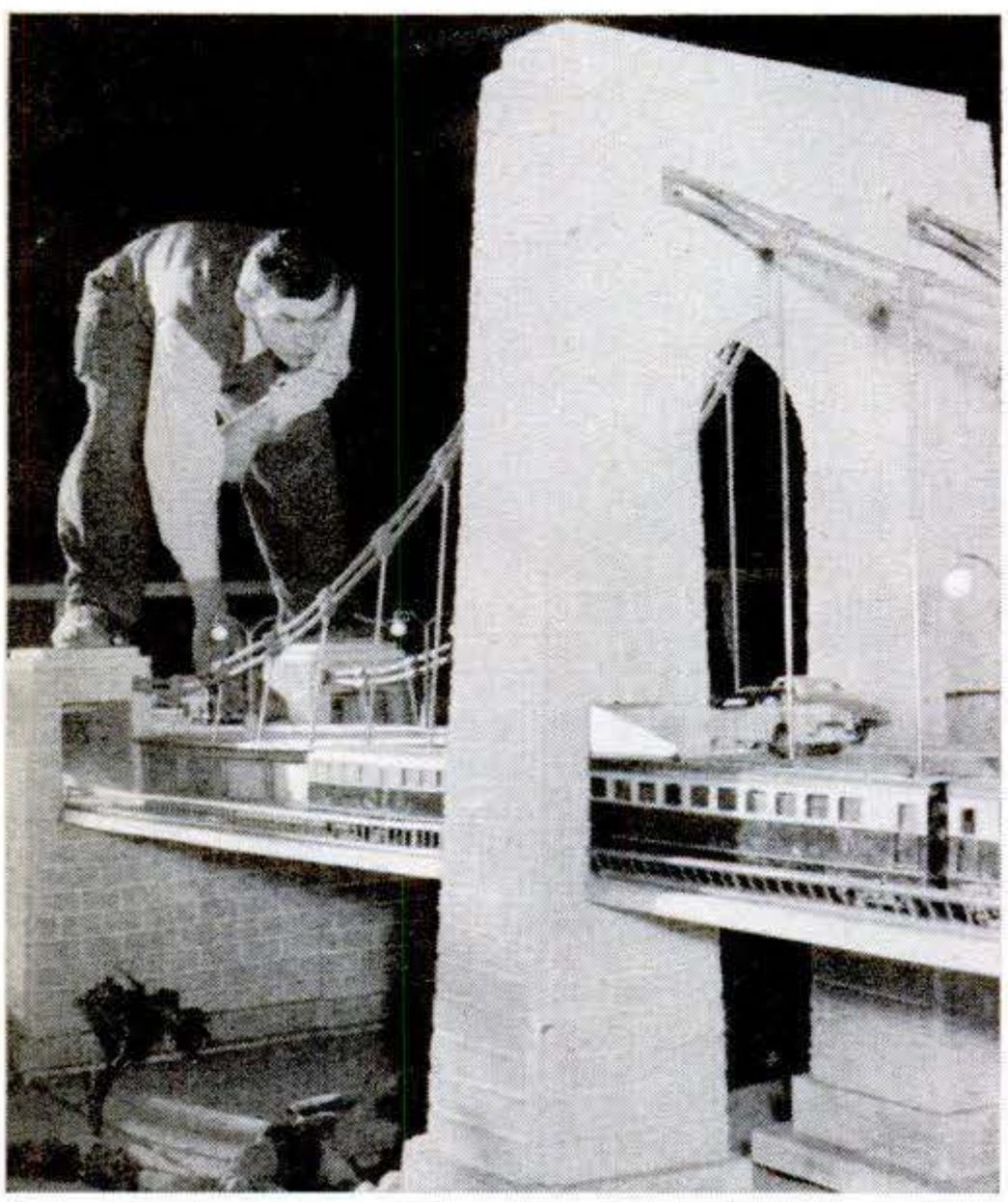
Midget Player Runs 50 Seconds

DRAWING its power from two flashlight batteries, this tiny record player spins 3½-inch disks. It's made for use in store displays. Each record delivers a 50-second sales pitch per side. Noma Lites, Inc., originally designed the tiny phonograph for use in talking toys.



Movie Shown Inside Big Pipe

WORKMEN above are watching a safety film in a huge siphon. Part of a network of irrigation canals under way in the state of Washington; the pipe was pressed into use as an impromptu theater because there was no building in the area large enough to hold the audience.



Traffic Snarl Solved by Model

THE suspension bridge above is part of a model city built by a German engineer for working out traffic problems. Streets and tracks spread out over 130 square yards—about half the area of a tennis court. All construction, including trains, streetcars and autos is done to scale, just 1/25 the size of the real thing.

Tricycle Helps Teach Art

THE boy on this tricycle is not going anywhere: he's learning to appreciate art. The setup is an audience-participation device concocted by New York's Museum of Modern Art. When the trike is pedaled, figures in the window revolve to create abstract designs suggesting airplanes, fish and boats.

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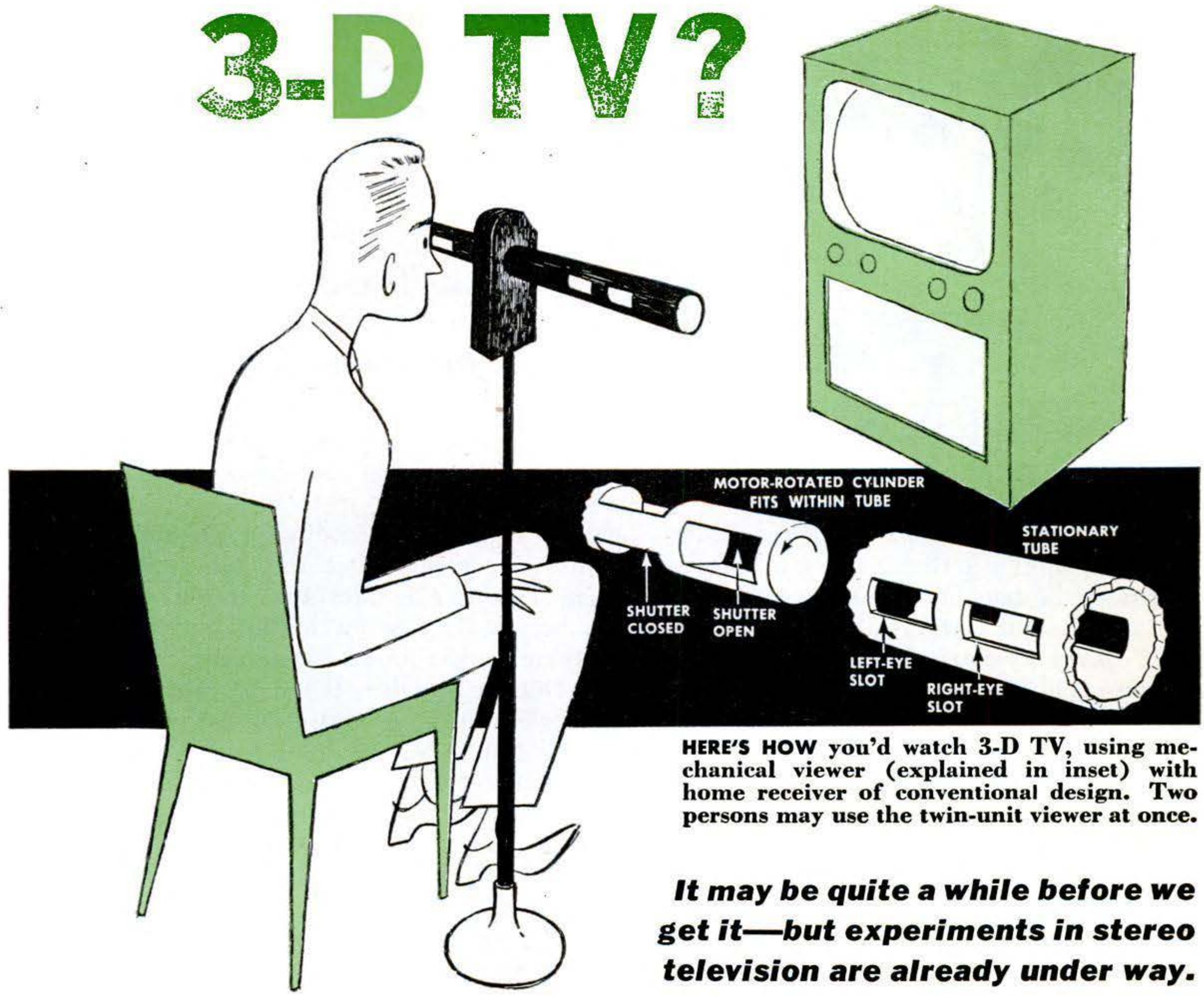
3-D TV?

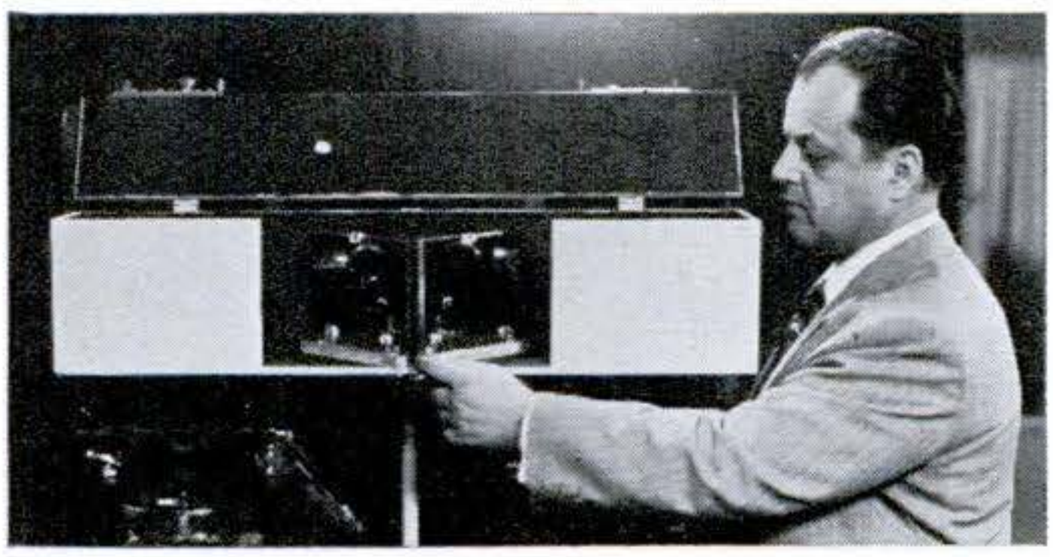


HERE'S HOW you'd watch 3-D TV, using mechanical viewer (explained in inset) with home receiver of conventional design. Two persons may use the twin-unit viewer at once.

It may be quite a while before we get it—but experiments in stereo television are already under way.

WILL TV match the movies' counterattraction, 3-D films, and come up with stereo pictures too?

One television pioneer, Ulysses A. Sanabria, is currently demonstrating in Chicago what may be the forerunner of 3-D TV. His hand-built outfit, whose pictures flicker like old-time movies, leaves many problems to be ironed out. But it works—entertainers do seem to step out of the screen and perform right before you.



PERISCOPE with oblique mirrors gives human-eyes' viewpoint to lenses of two cameras, side by side, that televise a 3-D scene. Their pictures are transmitted alternately.

To televise a scene in 3-D, two TV cameras peer through a horizontal periscope giving them a double perspective like human vision. An electronic switch alternately transmits what each camera sees. The result is a succession of left-eye and right-eye pictures, 15 of each per second.

You watch a standard home-type TV receiver through a viewing tube with eye slots. A revolving shutter, synchronized with the transmitter, uncovers the screen to your left eye and right eye in turn. Thus each eye sees the picture intended for it.

Using a mechanical viewer, whose principle dates back to 1850, sidesteps the formidable problems of adapting a home receiver to such 3-D viewing devices as either Polaroid or two-color spectacles. The latter would be unsuited, too, to color TV.

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New Queen

$29,200 car from Spain,

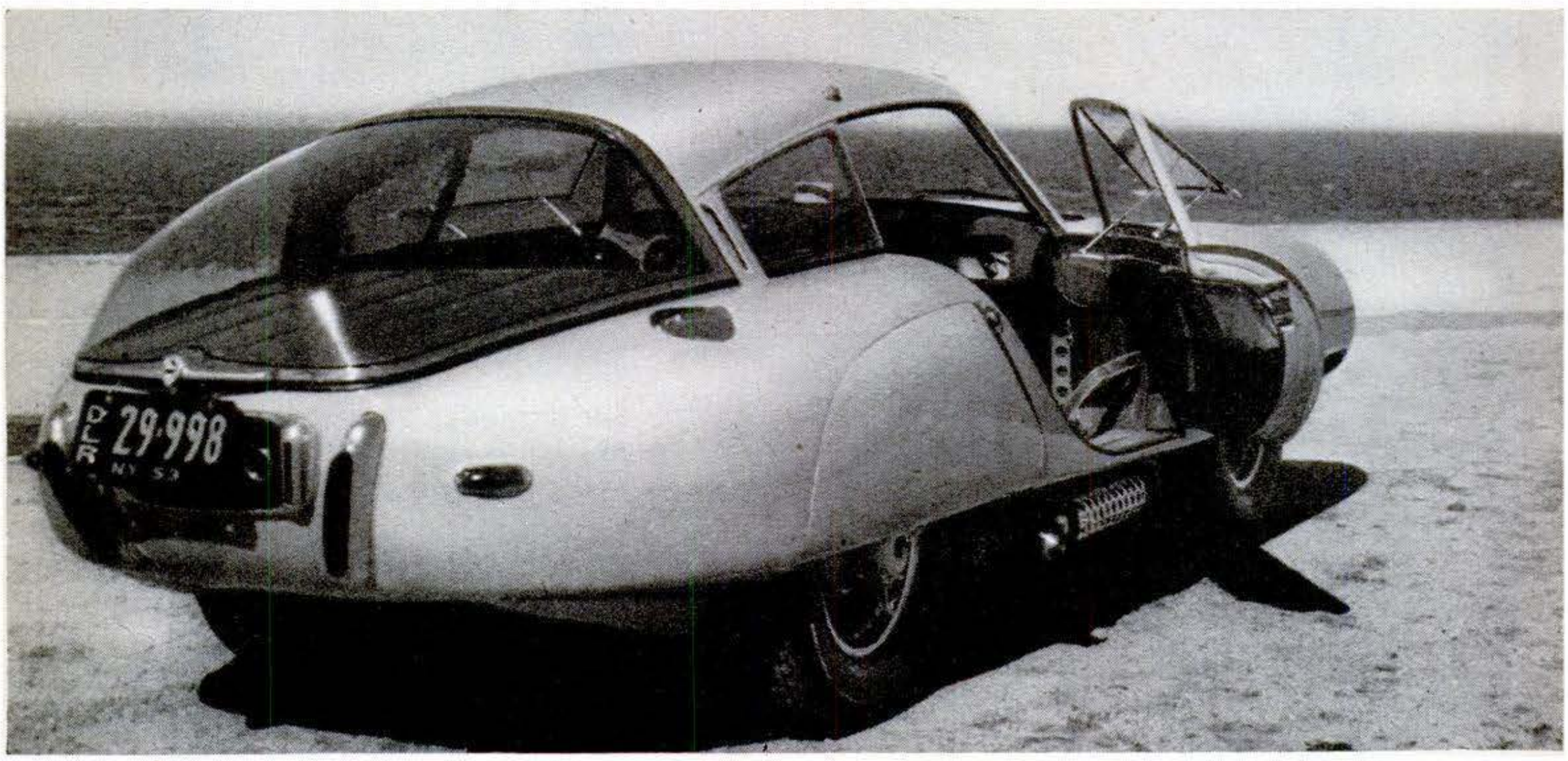
By Frank Rowsome Jr.

IF THAT spare $29,200 in the teapot on the mantel is getting to be a nuisance, consider the benefits of buying a de luxe Pegaso. It will certainly:

• ***Pop the eyes of the neighbors.*** The Pegaso is about as effective an attention-getting device as wearing a tuxedo while mowing the lawn. Park it on a city street and the sidewalk will clot with people; park it in a village and every small boy within 300 yards will be magnetically drawn; park it in front of your home and the Treasury will re-examine your tax returns. Even the troopers who fill out your speeding tickets will be fascinated.

• ***Pop your own eyes.*** If getting away first from the light is your vice, the Caddies, 88s and Jags that have been dusting you will learn how it feels. A supercharged Pegaso will handily hit 60 about 5.9 to six seconds after the light goes green. This is a comfortable second or two better than some highly coveted sports cars, and a round dozen faster than most Detroit brands. It will keep right *on* accelerating, too—way past the point around 120 miles an hour when you quick-shift into high. So sassy is the getaway, in fact, that the first times you belt the gas there's a problem in keeping your head from rolling back into the luggage deck, where it isn't very useful.

What's remarkable is that this Spanish sports car doesn't get its bullet-like performance purely by pouring on the



BUBBLE BACK gives fine rear vision. The plastic dome slides back and swings up, revealing spare tire and some luggage space. But like most sports cars, two passengers fill her up.

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Dazzles the Motor World

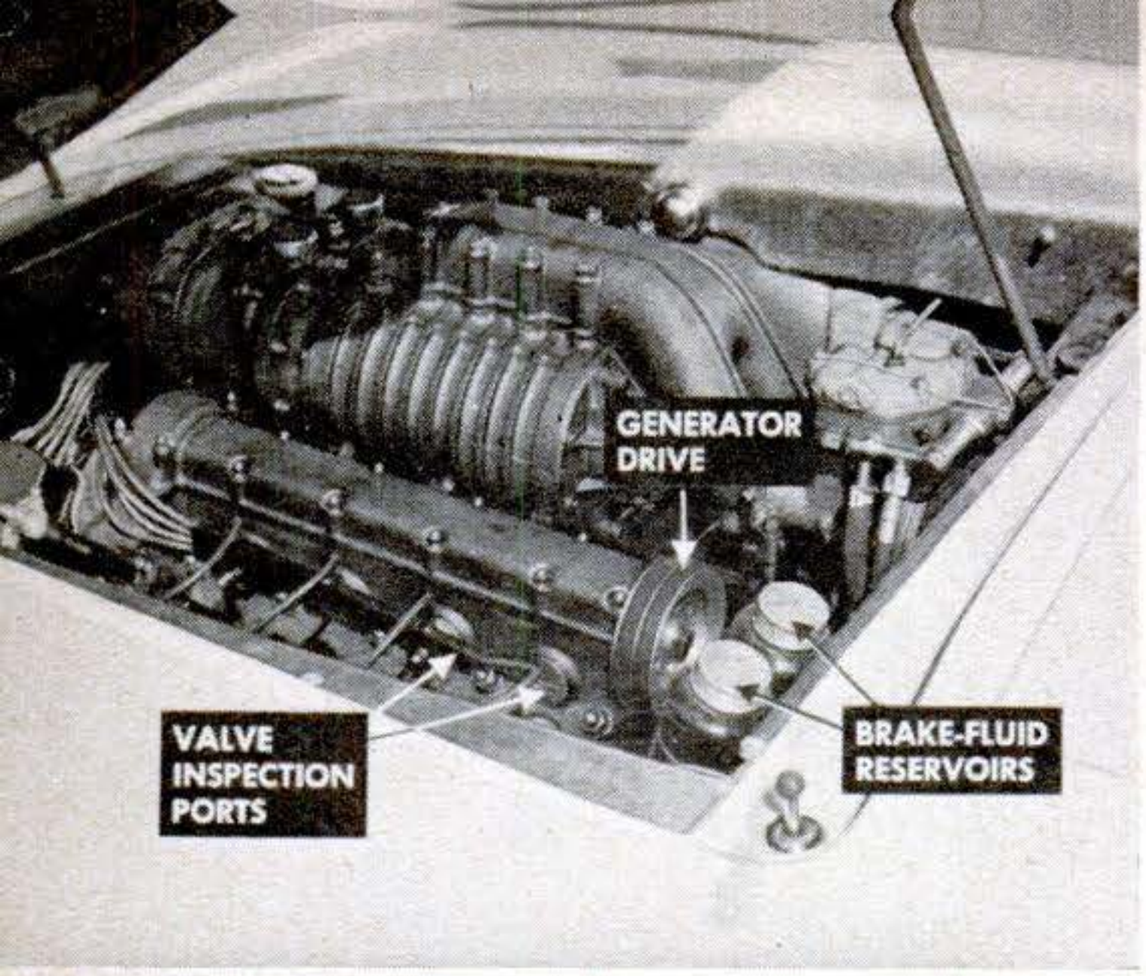
loaded with sass, style, and temperament,
makes a Jag look like a jeep.

horses. Measured in displacement, its 170.8 cubic-inch (2.8 liter) power plant is only about half the size of that in a big Chrysler or Cadillac. Pegaso gets its snap (and its spectacular road-keeping) from luxurious engine and chassis design.

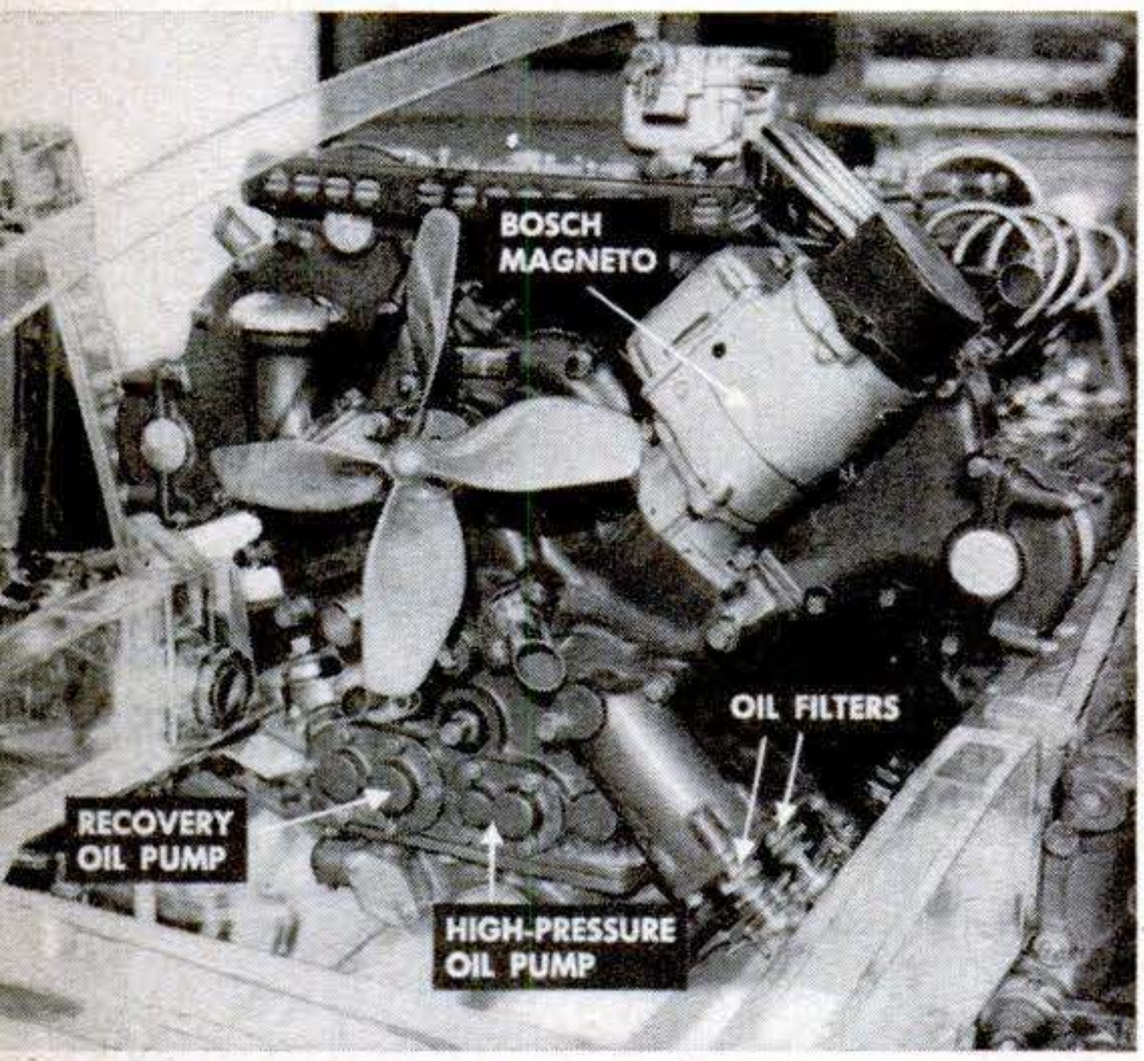
A designer's engine. The 90° V-8 that powers Peggy clearly shows a spare-no-expense approach. It is an "over-square" engine, with a 3.144-inch bore by a 2.751-inch stroke. Gear-driven from the front of the block are four overhead camshafts, fitted with high-lift cams and six bearings apiece. Big sodium-cooled valves, as handsomely finished as jewelry, are inclined into the hemispherical combustion chambers. The five-ring pistons can be had in nine different compression ratios up to 9 to 1, with 8- or 8.8-to-1 ratios favored among U. S.-imported models.

Since oil may run hot in a high-performance V-8 (crankcase cooling areas being comparatively small), Peggy is fitted with an elaborate 12.67-quart lubri-

DISHED DOOR gives more room inside, but window must swing out like those in a greenhouse. Strap below girl's left wrist secures a man's luggage case; woman's is on other side. Perforated guard prevents burns.

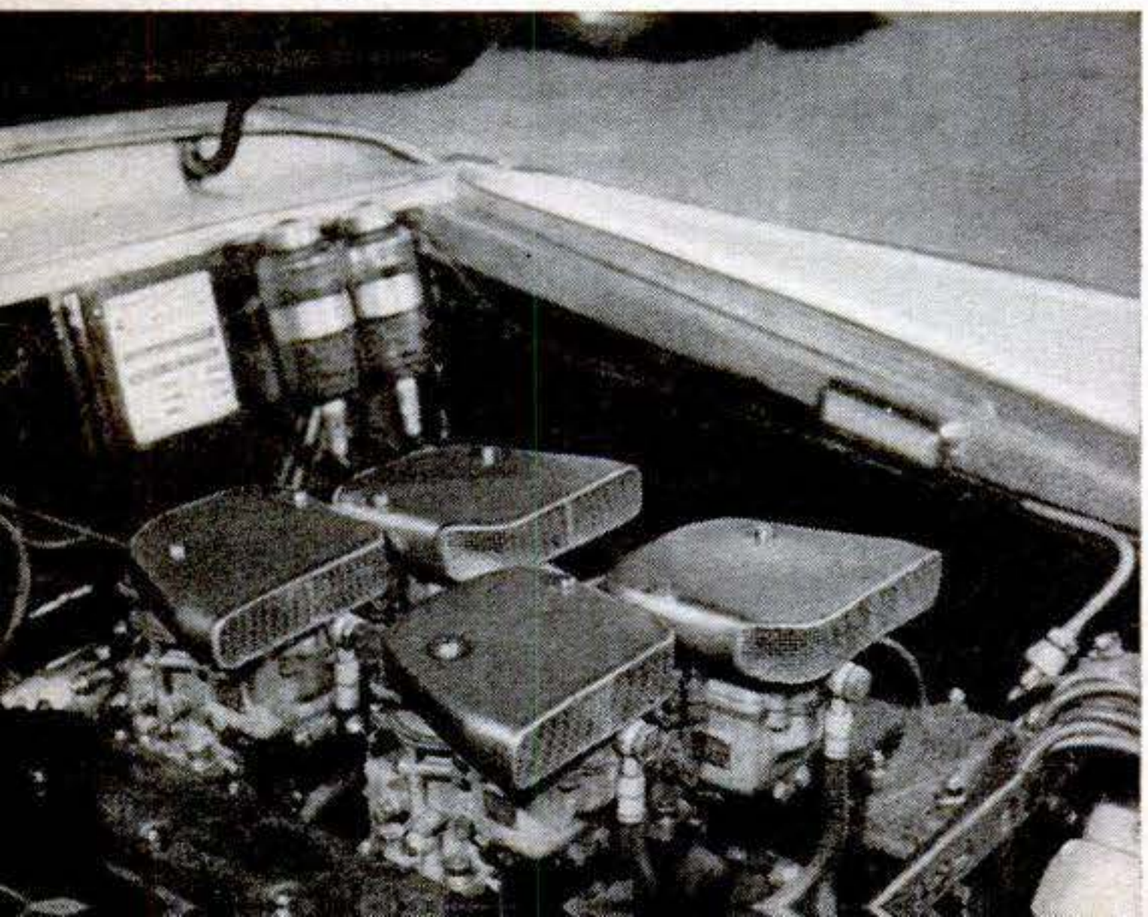


ROOTS BLOWER nestles in the engine's V. Taking in air through a scoop, it packs charge in with rotors turning at crankshaft speed. Engine has some brightwork and spot-turning, but is mostly a wrinkle finish.



GEAR-DRIVEN FAN, cast of light alloy, is machined all over. Irregular blade spacing minimizes resonance. Actual engines are almost as slick as this display cutaway. Magneto can be adjusted without knuckle-skinning.

FOUR-POT VERSION is quieter than blown engine, gives practically identical performance up to about 135 m.p.h. These Weber carbs are duals, so engine has equivalent of one carb per cylinder. Ducted hood rams air in.



cation system. One pump snatches oil from the dry sump under the crankshaft and sends it to an oil cooler located directly beneath the radiator. From here a separate high-pressure pump withdraws cooled oil, forces it through a pair of disk-type filters connected in parallel, and shoots it, at differentially adjustable pressures, to the five main bearings and the four camshafts.

Lush touches. As befits a de luxe mill, this V-8 is slick inside and out. Cylinder heads, sump, clutch housing and the main block itself are all cast of high-strength light alloy. Buried parts that most owners will never see are finished all over to a showcase polish. (This isn't pure swank, of course; it aids quality control and permits closer tolerances.)

Similar drafting-table lavishness also marks Peggy's cooling, ignition and fuel systems. There's a big radiator and a 22.17-quart water supply (Spain is hot and hilly). An intricate gallery of internal tubes leads water to the wet cylinder liners and the valves. Ignition is optionally 12-volt coil or Bosch magneto, the latter favored for competition cars. With an electric fuel pump acting as a booster, a mechanical pump powered by the right intake camshaft takes gasoline—preferably 80-octane or better—from the dual fuel tanks.

In the pot department a buyer can take his pick of 1) a single downdraft Weber that draws air through the ducted alligator hood, 2) four downdraft Webers, also duct-fed, or 3) a big Roots-type supercharger. This charming gadget, which will bite you for an additional $1,800, lets the engine peak above 6,500 r.p.m. and delivers flat-out speeds above 170 m.p.h. (If it is true, as Aldous Huxley claims, that speed is the only new sin invented in this century, Peggy is uncommonly sinful.)

How many horses? Considering that they named the car after the ancients' best-known horse, Pegaso's manufacturers are oddly skittish about horsepower claims. This is perhaps partly because of all the options. With two slightly different engine sizes (152.5 cu. in. as well as

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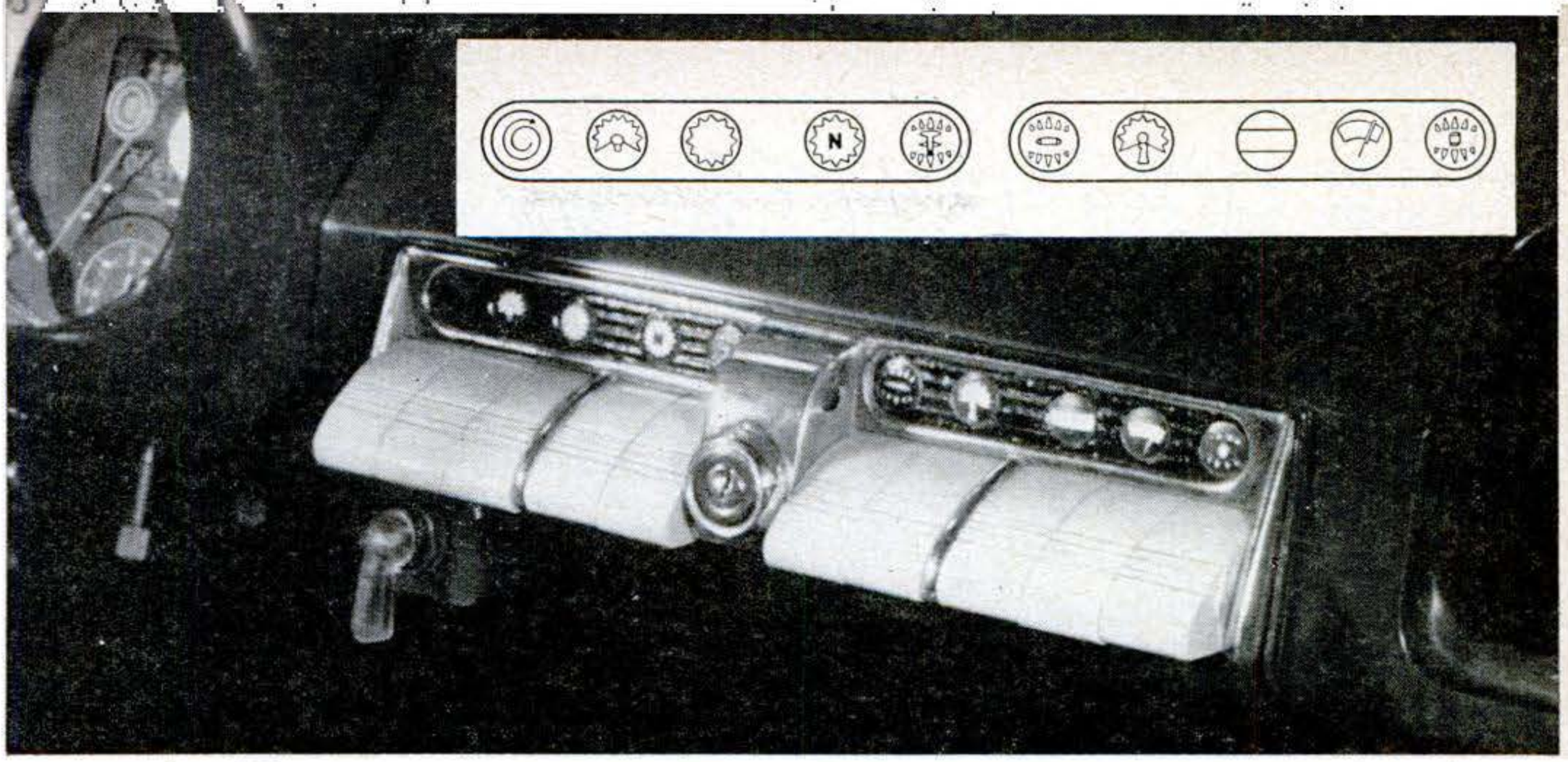

CONSOLE has 10 switches marked with symbols for owners who can't read Spanish. From left: starter; city beam; country beam; fog, panel, interior lights; switch that changes horn to headlight flasher; heater; wipers; parking lights. There's also a foot dip-switch.

170.8), nine compression ratios, two ignition systems, three carburetor options, and fuels ranging from 72-octane pump gas to methanol blends, there are dozens of possible combinations.

There's undoubtedly another reason for the lack of an official factory rating. Señor Wilfredo Ricart, Peggy's principal designer and the boss of the factory (Empresa Nacional de Autocamiones) is reportedly eager to avoid the competitive power claims that currently beset some U. S. makers. Entering the super-sports-car ranks of Ferrari, Cunningham, Mercedes, and Bentley Continental, ENASA as a newcomer to the field evidently prefers to avoid a horsepower war.

Power estimates, however, aren't lacking. The smaller engine, unsouped and with one carburetor, is believed to deliver about 140 hp. at 6,100 r.p.m. The larger version, with four carbs and a Bosch magneto, is pegged at about 170 to 190 hp., and the blower-equipped jobs are reputed to put out well over 200 hp. at 6,500 revs.

Rear end. The drive system by which these horses get to work is also elegant. There's a single-disk dry clutch just astern of the flywheel, followed by a long snout on the clutch housing to reduce the length of the open propeller shaft. From this shaft the power train then unconventionally ducks past the differential to a five-speed transmission located out in back. (Which explains why Peggy has twin fuel tanks.) From the gearbox power passes forward to the differential and aside to each wheel. In this modified de Dion rear end, unsprung weight is close to a minimum and there's no bulge to the rear elevation. Seen on the road from behind (which is where you'll mainly see it from), Peggy has a flat-bottomed rear.

Transmission. It appears to be a mistake to shift gears on a Pegaso with cautious delicacy. Not that you can't; the gearbox is synchronized in the upper four of its five speeds. But the little slices of a second used up by careful shifting needn't be spent—you can just haul off and fetch the shift lever a stinging wallop. A driver who feels real uppity can even upshift or downshift without bothering with the clutch. A sensitive accelerator foot, immense assurance, and a stiff right cross to the shift lever do the trick. If your assurance doesn't falter, she won't spit gear teeth back at you.

Brakes, front end, steering. Two transparent reservoirs on the fire wall feed reserve brake fluid to the master cylinder. Peggy has two entirely separate braking systems, one each for the front and rear wheels. An unusually large lining area (190 sq. in.) is provided to prevent brake fade. Since the rear brakes, being inboard, are shielded from the regular air flow, two scoops beneath shoot up cooling air around the finned drums.

The front suspension uses radius arms and torsion-bar springing. The telescop-

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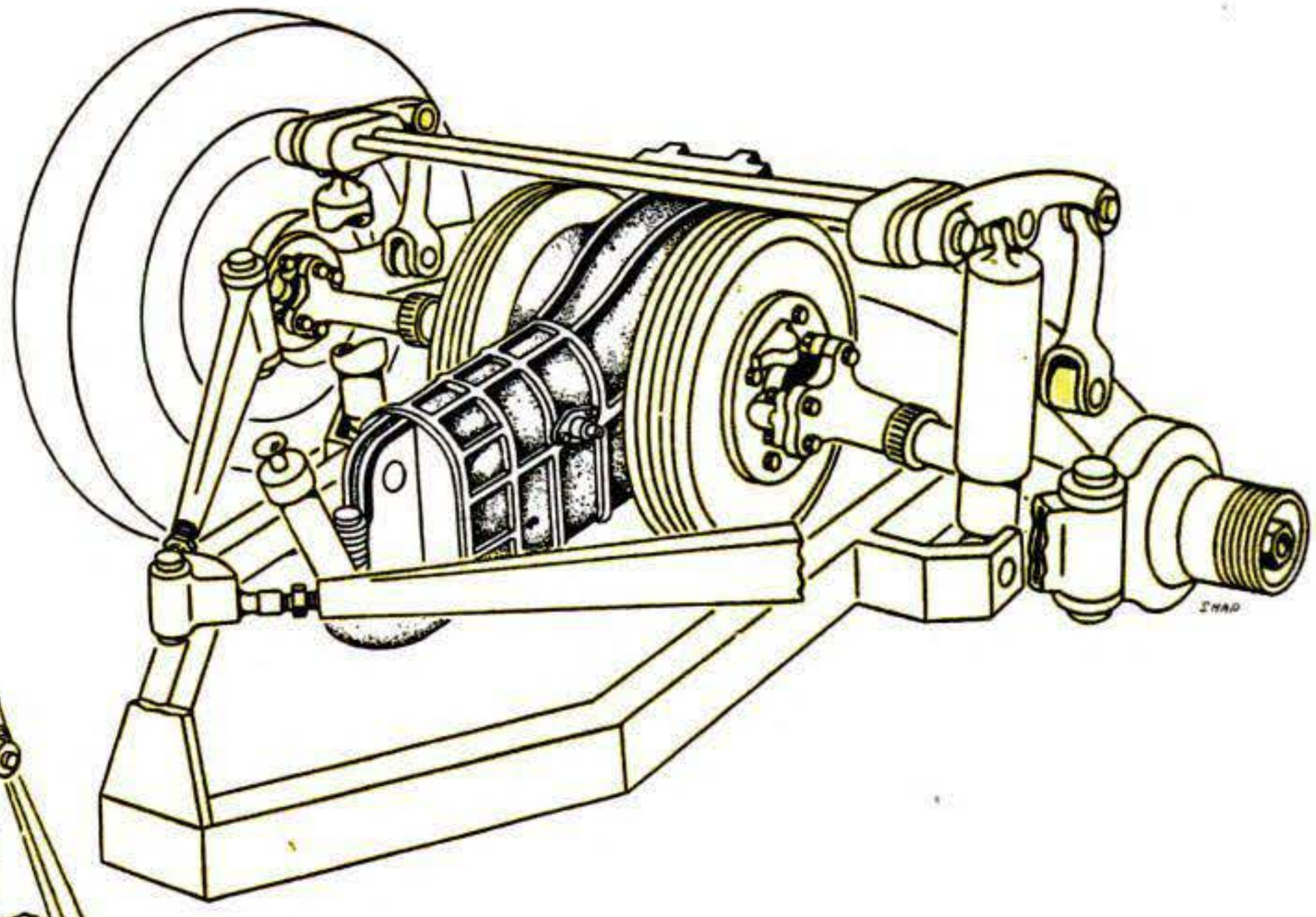
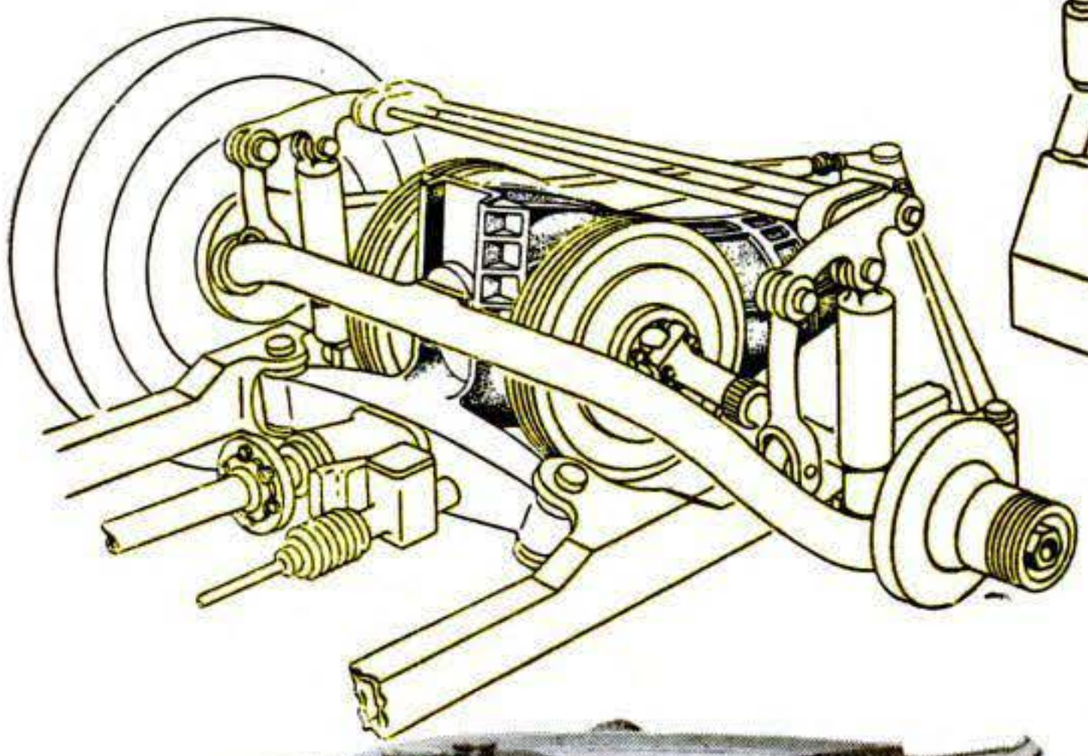
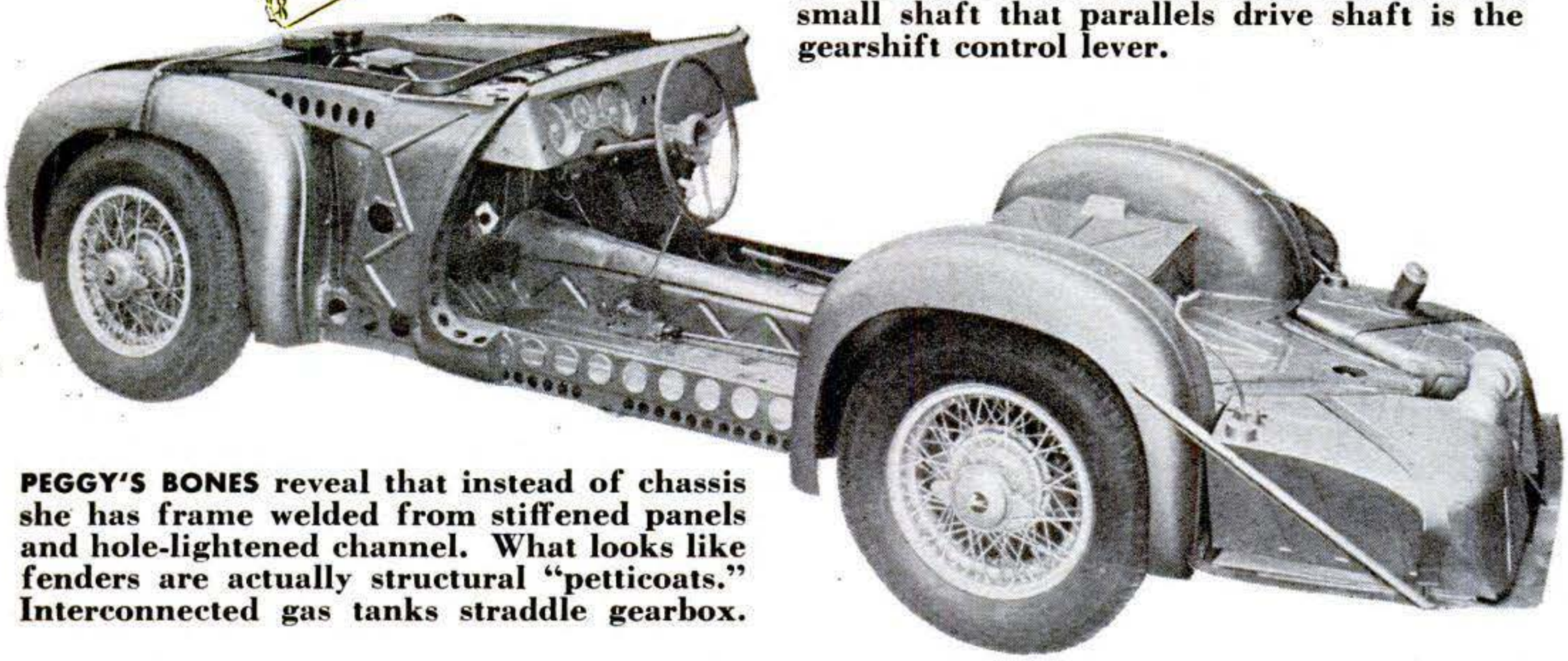


TRANSMISSION trails behind rear end, as shown in view from behind (right). Slanting object at end of transmission is dip-stick and filler. Gearbox has its own oil pump and filter. In this de Dion rear end, torsion bars support differential and brakes, cutting unsprung weight.



SIDE THRUST on rear wheels is transferred by bent crossover tube fitted with little wheel that rides in channel cast in differential housing. Radius rods out back also tie rear wheels. In drawing at left (from side, looking back), small shaft that parallels drive shaft is the gearshift control lever.



PEGGY'S BONES reveal that instead of chassis she has frame welded from stiffened panels and hole-lightened channel. What looks like fenders are actually structural "petticoats." Interconnected gas tanks straddle gearbox.

ing shocks are of ENASA's own design and seem to be a big factor in the car's rail-like road-keeping. The steering gear, also the company's own, uses a vertical gearbox from which the link runs straight forward. Its ratio is abnormally "fast"—you move the wheel only 1.7 turns from full left to full right. (This isn't obtained by limiting wheel swing, either, since the car has a 31-foot turning circle.) Though applauded by many racing drivers, such fast steering gives Peggy a nerve-wracking responsiveness.

Peggy weighs 1,950 pounds without the thin aluminum body; curb weight runs from 2,150 to 2,350 pounds. This is roughly half a ton less than a Chevvy.

She is deceptively small. The wheelbase is almost two feet shorter than a current Ford's, and the height, depending on what body is fitted, comes about to your shirt pocket. But there's 6.3 inches of road clearance.

Despite the horses under the hood, fuel mileage is quite good. Señor Ricart, Peggy's papa, reports 26 miles per gallon at a 70-m.p.h. average on hilly Spanish roads. Although this was in a one-carb car, it indicates that the hotter versions won't be gas-hogs by U. S. standards. It also suggests the warming thought that, having laid out $20,000 or $30,000 for a Peggy, you can save at the pumps.

How much, really? The supercharged job shown here is tagged at $29,200, delivered in the U. S. It is, however, obviously "loaded." Brewster Motors of

[Continued on page 256]

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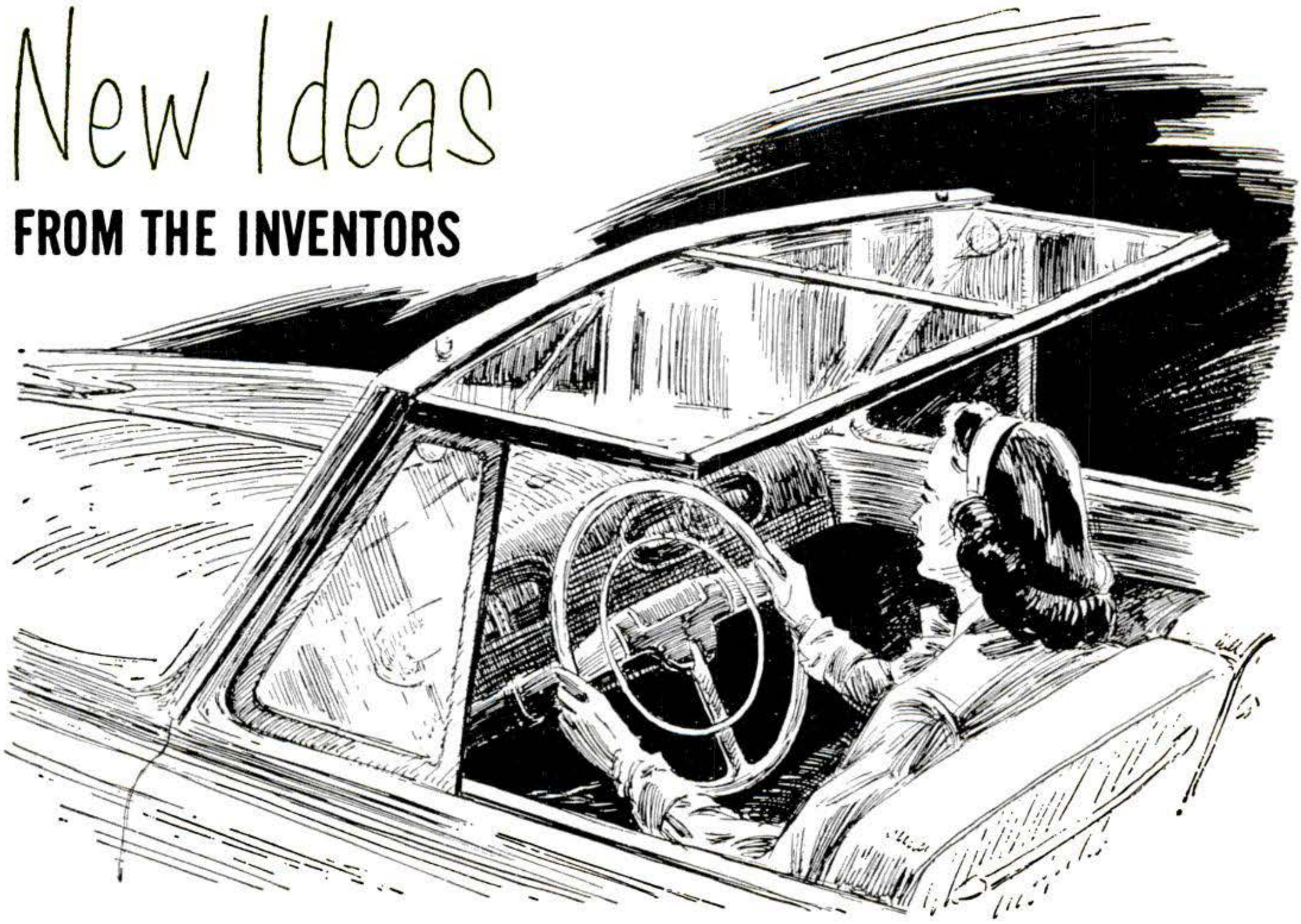
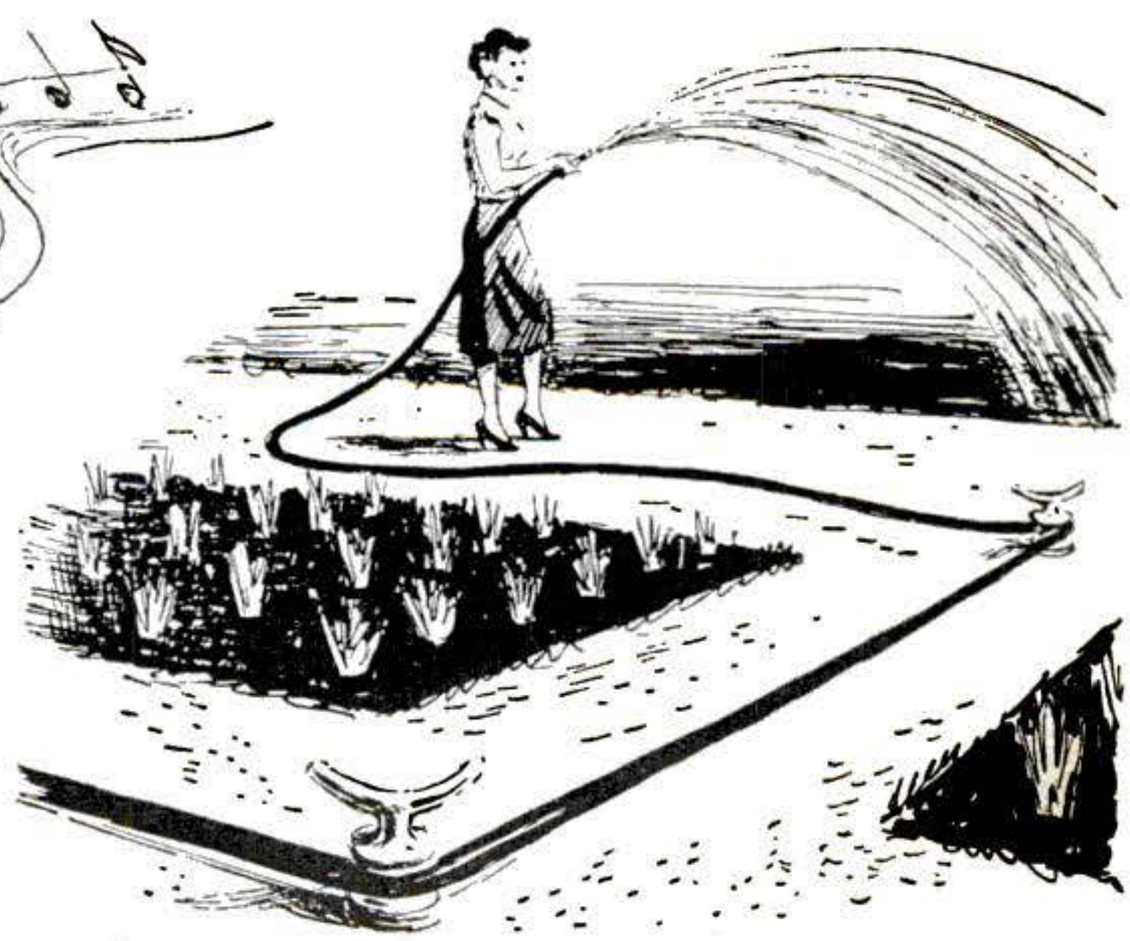
New Ideas
FROM THE INVENTORS



1 Hood to Stop Open-Car Drafts. Keeping your hat on—or your hairdo in place—in a convertible would be easier if the car had an overhead windshield like this recently patented one. It would be bolted to the regular windshield and could be raised, lowered or tilted to suit the passengers and the weather. It would not interfere with the top. When covered by the top, the windshield would serve as an overhead map shelf.

2 Bike to Sing to Rider. A grooved metal record attached to any standard bicycle wheel would help a cyclist while away the miles. A playback stylus hooked to the front-wheel fork would follow the record groove. The recording would be audible to the rider and might also serve as a signal to nearby pedestrians.



3 Hose Guide to Protect Plants. The garden hose could not damage your fragile plants if you snaked it around the flower-bed margins with these removable roller guides. A long pointed spike and a convenient handle on each guide would make it easy for you to sink it into the ground or pull it up quickly.

Please turn the page for more new ideas.

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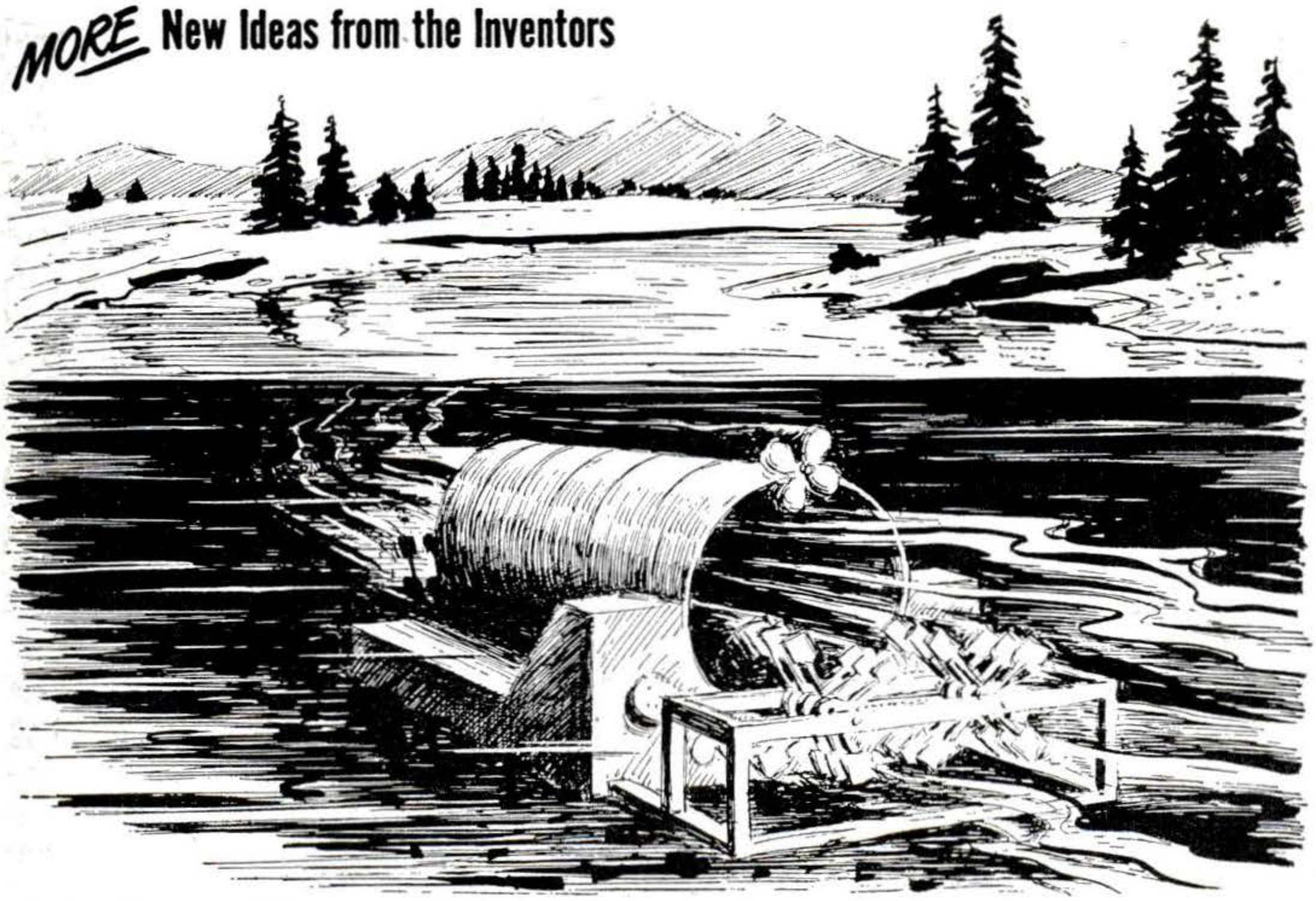
MORE New Ideas from the Inventors



4 Machine to Mine Ore Under Water. Placed on a river bed, this tube would strain ores and precious stones out of the flowing water. The inventor claims that a proper combination of stirrers, sifters and washing machines could collect river sediment and separate heavy metals and gems from lighter sand, soil and stones. Valuable ores would be deposited in the lower chamber, the rest passed back into the river.

5 Dummy Car to Slow Speeders. A movable roadside sign made to look like the back of a police car might discourage speeding and reckless driving. Speeders who were wise to the trick would have to slow down anyway because the billboard could conceal a real police car.

6 Handle to Hold Paint Can and Brush. This holder would solve two standard painting problems: how to pick up the can and where to put down the brush. You would loop the flexible strap around the can and snap the two handle halves together to form a can holder and brush clip.

U. S. patents on these inventions have been granted to: 1. James L. Matheny and Richard H. Perkins, Santa Ana, Calif.; 2. Robert E. Mueller, NYC; 3. Merritt B. Austin Jr., Deerfield, Ill.; 4. William T. Vogelpoel, Surabaya, N.E.I.; 5. William Taylor, John Worsham and John Davis, Oakland, Calif.; 6. Eduard Dechar, NYC.

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Anybody Can Build a House

With cash and on-the-job advice, a Cleveland bank helped more than 300 amateurs build homes.

By Wesley S. Griswold

THANKSGIVING DAY, 1951, was a bad day for Cleveland, and especially for Louis Vash, who was building his own home. One of the heaviest early snowfalls in local history paralyzed the city. It threatened to squash Vash's unfinished house. The roof, which he had shingled a few days earlier, settled under the weight of the wet snow and pushed one of the living-room walls three-quarters of an inch out of line.

Vash desperately called for help—not from friends, family or the fire department, but from a bank. It was the bank that was financing his building program. You might think that this was about as sensible as notifying the corner drugstore of a flat on your car. But the vice-president of this bank—big, bluff Oscar A. Maeder—was once a bricklayer. He has spent most of his life supervising construction, and he came a-running.

Vash, meanwhile, excitedly climbed onto the roof and began rolling big snow-

ONCE A BRICKLAYER, then an electrician, Roy Rouzer of Mayfield Heights, Ohio, had never tried carpentry until he built his own house. He hired a carpenter for just one day.

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balls off. By the time Maeder got there, the roof was nearly clear. "I think I ought to fasten a cable to the wall that's leaning, and to the straight wall opposite," he told his rescuer. "Then put a turnbuckle in the middle and haul in the bulging wall with that."

"Okay," said Maeder. "But do you know why this happened?"

Vash didn't.

"Well, for one thing, your roof isn't properly braced," Maeder explained. "And, look there—that double plate, just where the frame of the kitchen meets the frame of the living room. You hardly lapped those two-by-fours at all. They tie the front and rear of the house together, man. Why, you've practically got an open joint there!"

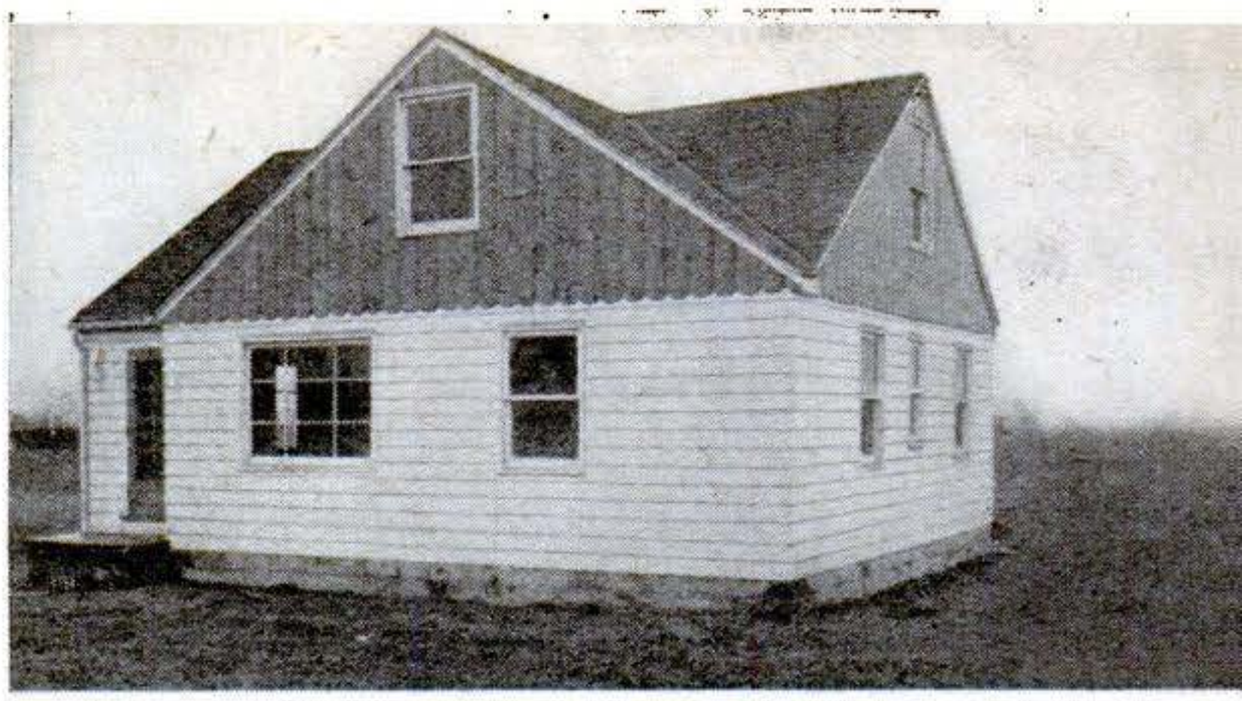
Offers Remedy

Maeder showed Vash how and where to brace the roof and how to put strength in the weakened partition by making a new double plate, amply lapped. Then he hurried on to deal with other people's emergencies.

The bank he serves is Cleveland's Second Federal Savings and Loan Association, which is an interesting institution. It makes a good many of the usual kind of construction loans, but for the last three years, it has also been lending money for housebuilding on a new and unusual basis. C. W. Grove, a hearty, dynamic ex-contractor who founded the Second Federal with a little more than $7,000 in 1934 and has guided it so successfully that it now has assets of more than $40,000,000, believes that almost anybody can build a house. Anybody, that is, who has a deep desire to do so, perhaps a little know-how, a willingness to learn—and expert coaching.

Bank Provides Coaches

The Second Federal backs Grove's belief in amateur homebuilders with cash—not in a lump sum but as the bills come in—and provides the coaches: trouble-shooting Oscar Maeder and a younger man, Robert F. Derry, an assistant vice-president who is a trained architect. They regularly inspect the houses going up, give seasoned advice, and anticipate trouble if possible.



NEAT AND NIFTY is the house of apprentice patternmaker Charles Nord. It was finished in a record time of 10 months with the help of his father. Wife came in handy, too.

Since March, 1950, more than 300 residents of Greater Cleveland have got the Second Federal's approval to go ahead and start building at the bank's expense. They have included such unlikely homebuilders as a bass-fiddle player, an airline pilot, a tailor, a typesetter, a fireman, a bartender, a salesman of television sets, a truck driver, a pressman, an ad-agency employee and the supervisor of a tabulating-machine unit in a factory.

And the houses they have built cost them *at least a third* less than if they had hired the work done.

Maeder, who does most of the inspecting and supervising of owner-built houses for the bank, has hardly any more freedom than a doctor. Inexperienced bricklayers, masons, carpenters and plumbers don't hesitate to telephone him with their problems at any hour.

THIS TRUCK DRIVER, L. J. Thomas, of a Cleveland suburb, helped two neighbors build their homes. He learned enough that way to build his own, and they repaid his help.

No owner-builder in the bank's records has put up a house singlehanded. The bank won't let any amateur do plastering, for instance. That must be done by professionals, and when skilled help is needed for the more specialized jobs, the bank insists that union labor be hired.

Aside from plasterers, the union men most often called in are plumbers, electricians and installers of heating equipment. Frequently the owner of the house under construction works as a skilled workman's helper, both to speed the job and to learn how to do it.

Every owner-builder has relied to

THE FIRST THREE MONTHS (excavation, foundation, framing) are hardest for amateurs. The Thomas house, begun in June, 1950, was this far along after three months.

READY TO MOVE INTO when the first snow fell, the Thomas home still needed lots of finish work inside. Thomas and his 14-year-old son cleaned it up nights and weekends.

some extent on friends and relatives, too. Their building experiences may not have been any broader than his, but they often have read about or observed some detail of house construction that he knows nothing about. They pool their knowledge and frequently offer their labor on a loan basis, to be repaid when they start building houses of their own.

Many a man who has built a home for himself with the aid of the Second Federal has first helped someone else build his. And most of the amateurs have read books on the subject. Maeder, on visits to construction sites, has often found a volume on carpentry or some other pertinent topic lying open on a keg of nails.

Back Issues of PSM Helped

Ernest Pocek, a typesetter who now is comfortably settled with his young wife and two lively small sons in a handsome ranch-type house he built in Orange Village, a Cleveland suburb, says he got a lot of help from library books. He also gives considerable credit to a well-worn book in which he had had bound the Mechanics and Homebuilding sections from several years' issues of POPULAR SCIENCE MONTHLY.

Pocek's experience was typical in a number of ways.

He and his wife had spent three discouraging years hunting for a new house more spacious and attractive than the little boxes springing up in neighboring real-estate developments, yet within their means. Finally, they bought an appealing lot with some small trees on it.

"Someday we'll build," they agreed.

When they heard about the Second Federal's program, they applied for a loan. First the bank interviewed Pocek, appraising his personality, the seriousness of his intentions, his know-how, his ability to meet payments. Did he have at least $1,500 in cash? He did.

Then the plans and specifications for the house he proposed to build were carefully scanned. Pocek and his wife had selected a plan from a commercial book of five-dollar plans and had ordered blueprints for it. Nearly every owner-builder has chosen his house plan this way. Hardly anyone was competent to draw his own plans or felt that he could afford an architect.

The bank also looked over the bids to furnish materials that Pocek had been collecting. It sent a man out to inspect Pocek's lot. The bank can't afford to risk having to take over a property it would have a hard time selling.

Bank Approved Project

When the loan was approved, Pocek set to work. The day was May 12, 1951.

His only experience for the big job ahead had been gained in a basement workshop in his former home, where he had turned out a few pieces of furniture, a couple of cabinets.

APPRENTICE ELECTRICIAN Harold J. Miller took readily to other phases of house construction. He and his brother built the home below near Cleveland in 11 months.

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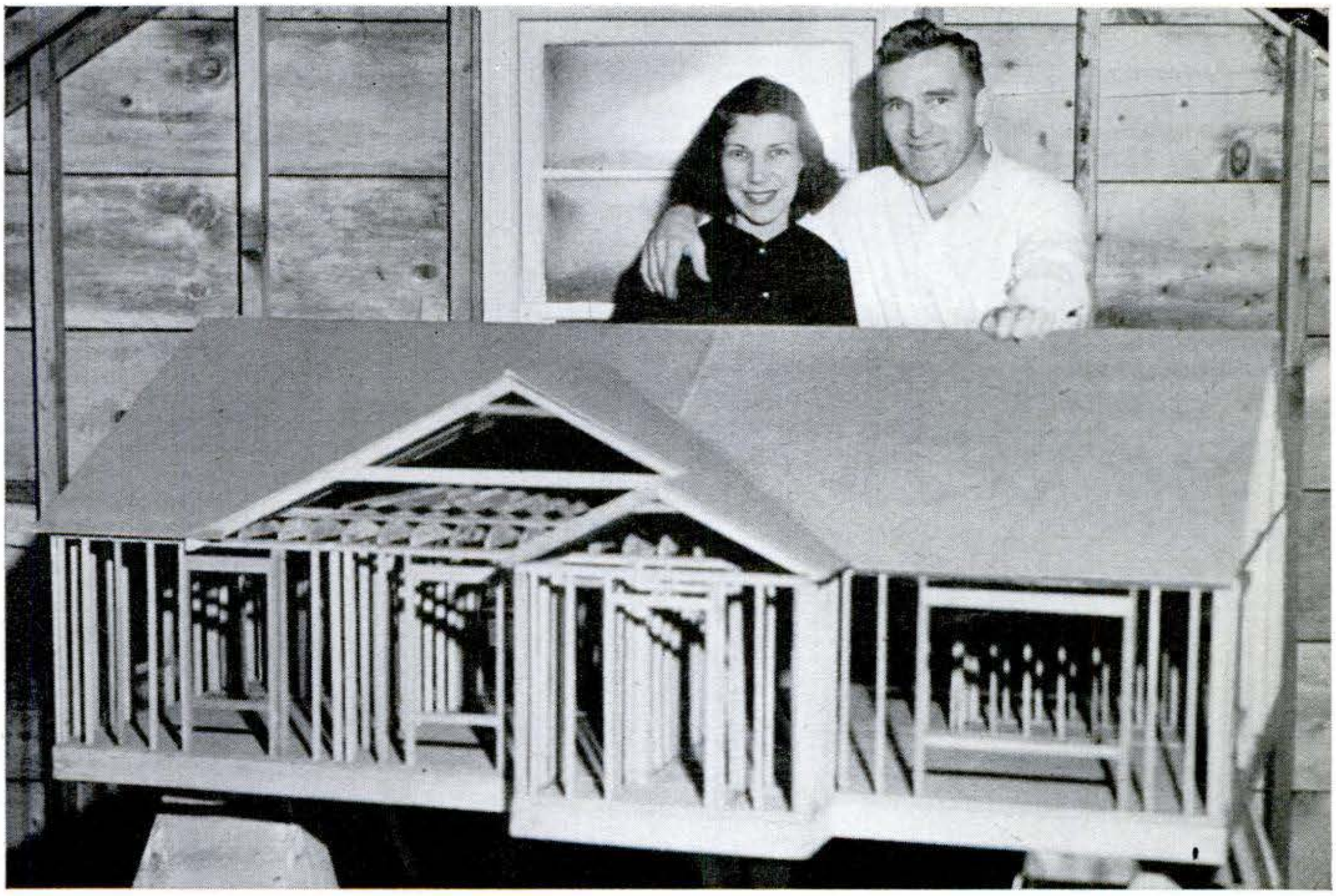


PRACTICE MAKES PERFECT, and Bart J. Foley, a Cleveland fireman, learned how to build his house by first making this scale model, one-eighth inch to the foot.

One treasure he had retained from those days was a portable electric handsaw.

"I couldn't have built the house without it," he said fervently. "Whatever you pay for it you earn back the first week you use it."

Pocek worked on the house nights, weekends and throughout his vacation. His wife helped, as most wives do.

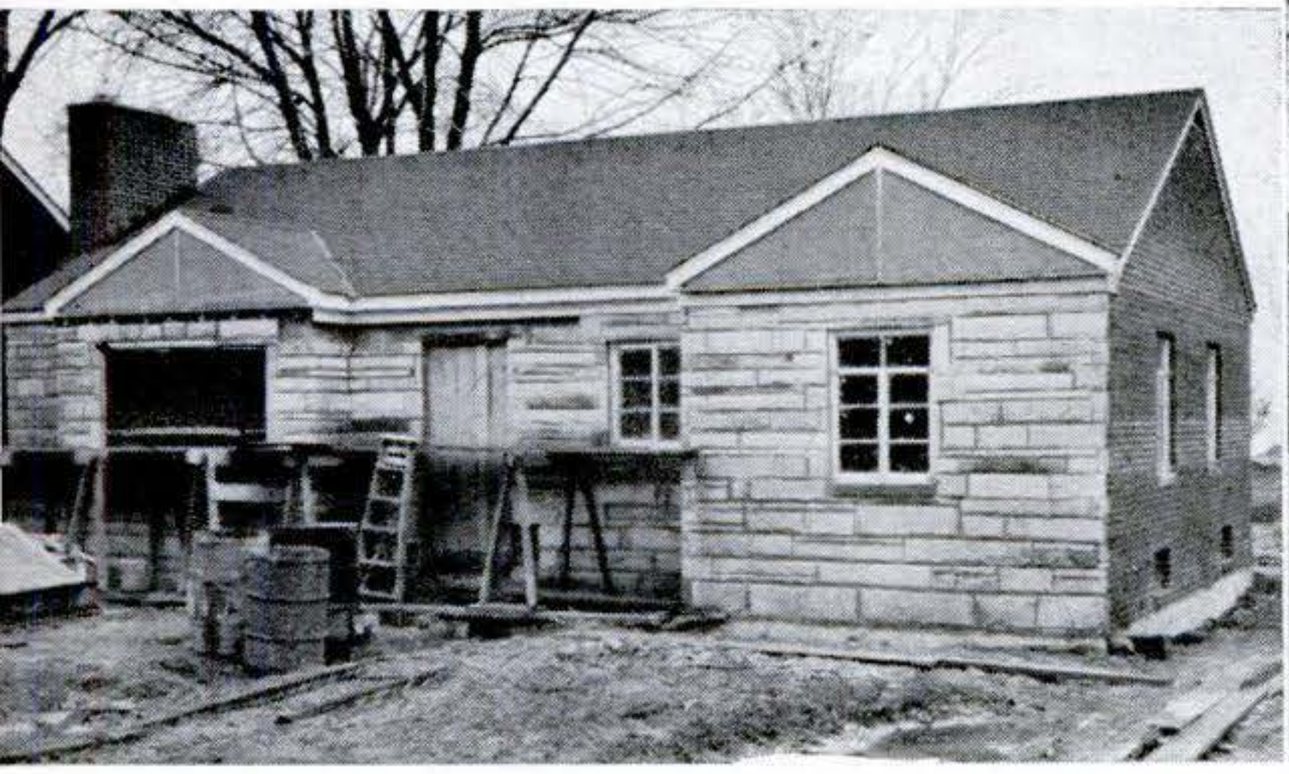
"I got all the dirty jobs," Mrs. Pocek remarked with a grin. "Sanding, filling in nail holes, putting on the priming coat outside."

A union bricklayer built the chimney and fireplace. Union plasterers and heating installers did their parts of the job.

All the rest of the house was built by Ernest Pocek, with occasional help from

[Continued on page 244]

STONE VENEER across front of house below was an added touch put on by William N. Minitch, a Cleveland custom tailor. At right, he and his son do some nailing.



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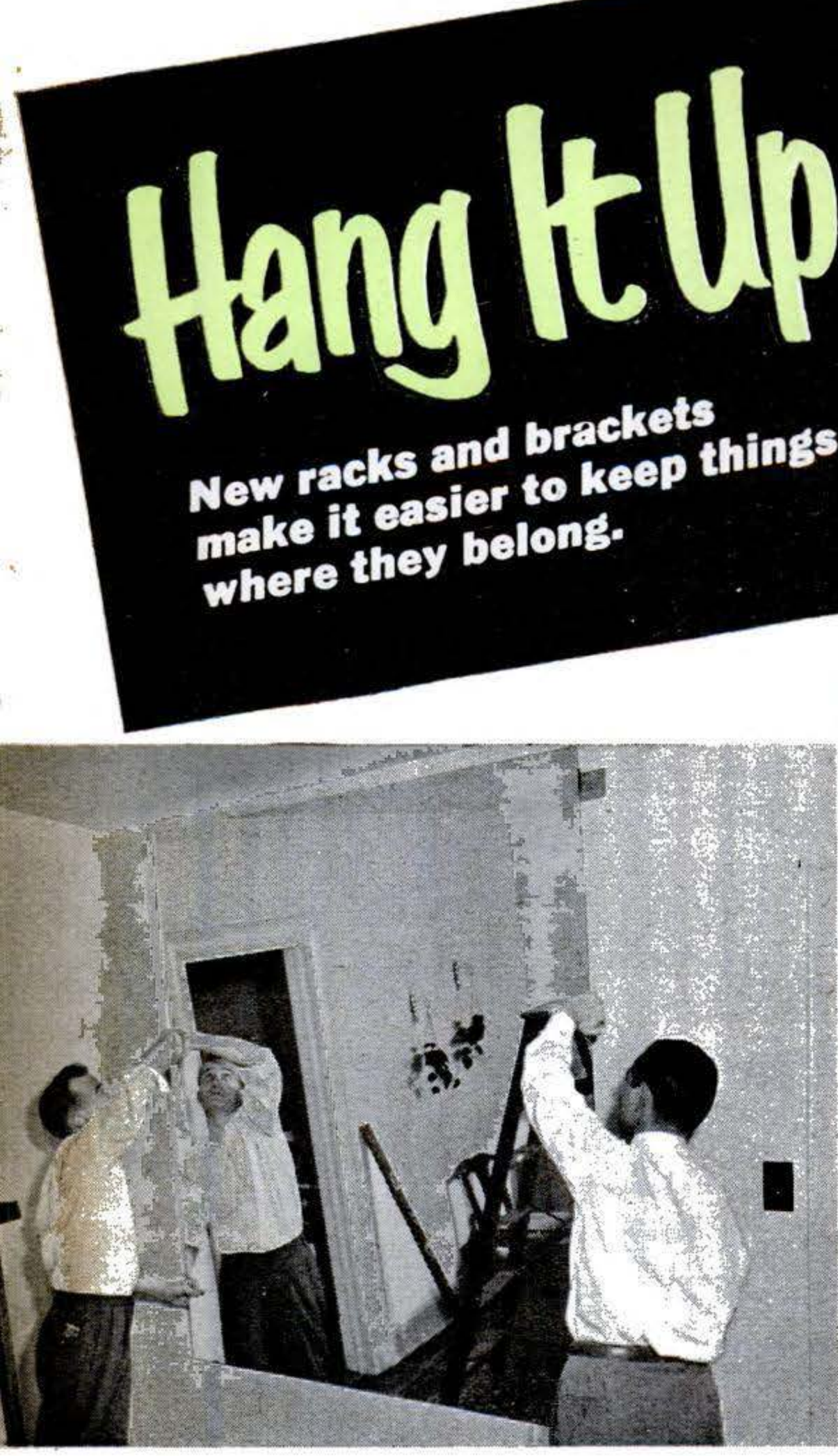
Hang It Up

New racks and brackets make it easier to keep things where they belong.



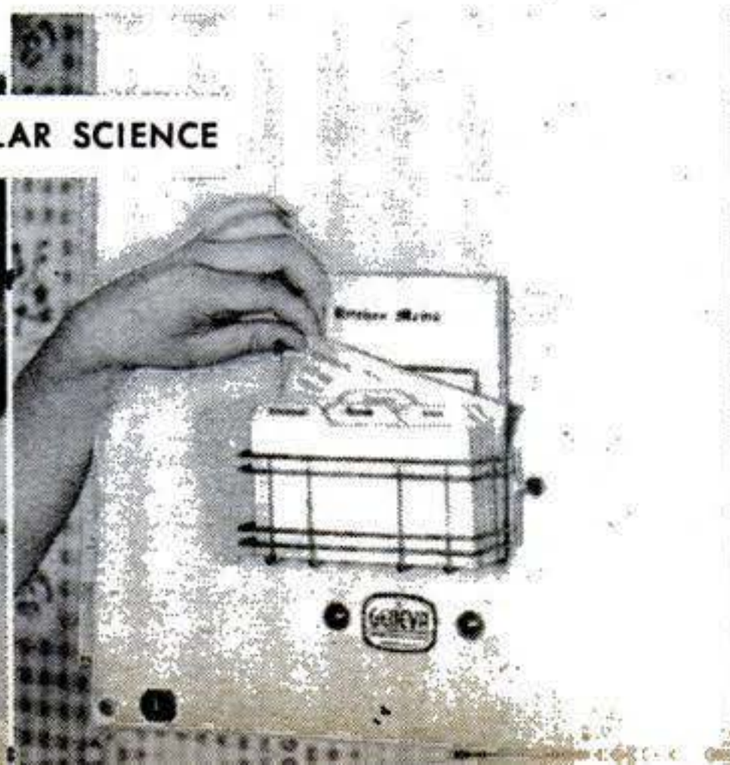
1. Special brackets make hanging a king-size mirror a job you can handle yourself with an assist from a neighbor for Operation Big Lift. Made of perforated metal with felt-padded clips to hold the mirror, the brackets are fastened to the wall with wood screws or toggle bolts.

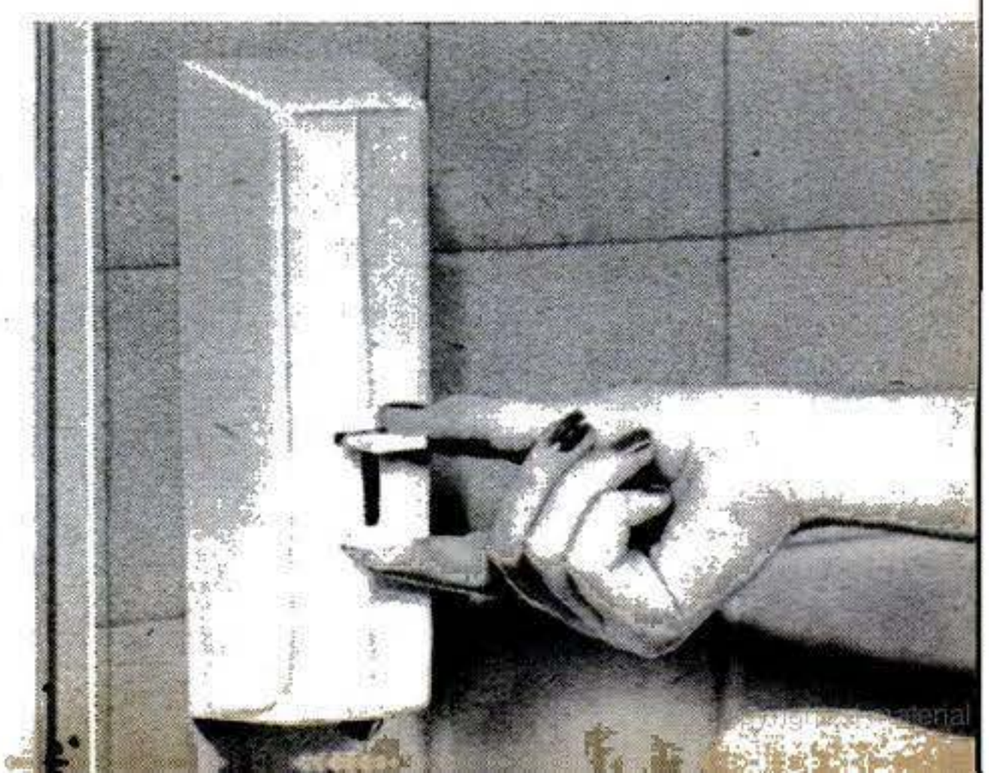
The lower bracket goes up first; then the upper one, with its ratchet clips in a raised position. The mirror is lifted into the clips on the lower bracket and pressed to the wall against the top bracket. The ratchet clips are lowered and the job is done. The brackets are made in three sizes for hanging custom-made mirrors ranging from 28 to 80 inches in length.

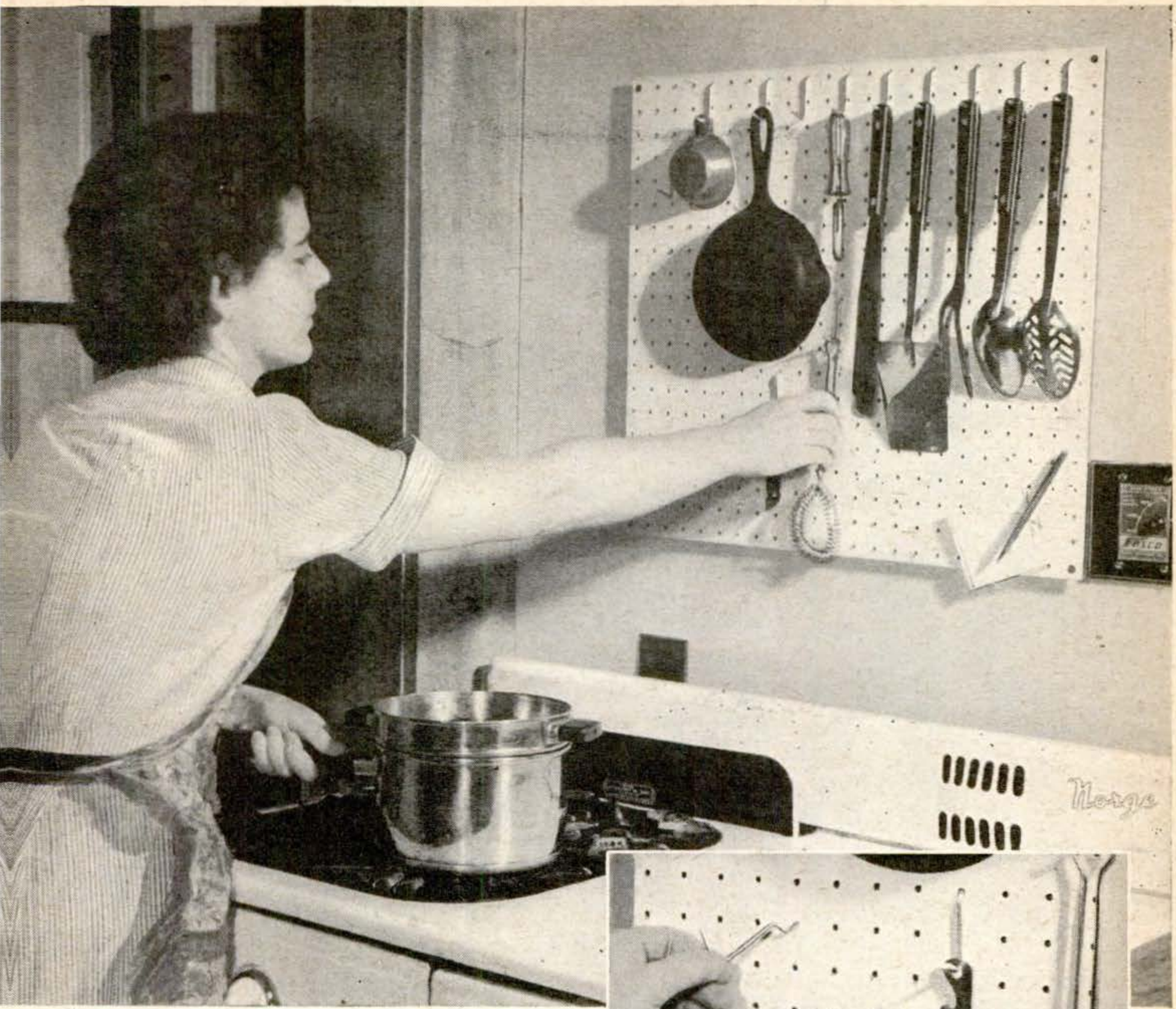
3. Upended on rods, rainy-day footgear dries faster, is kept off the floor. The Rubber Tree holds six pairs.

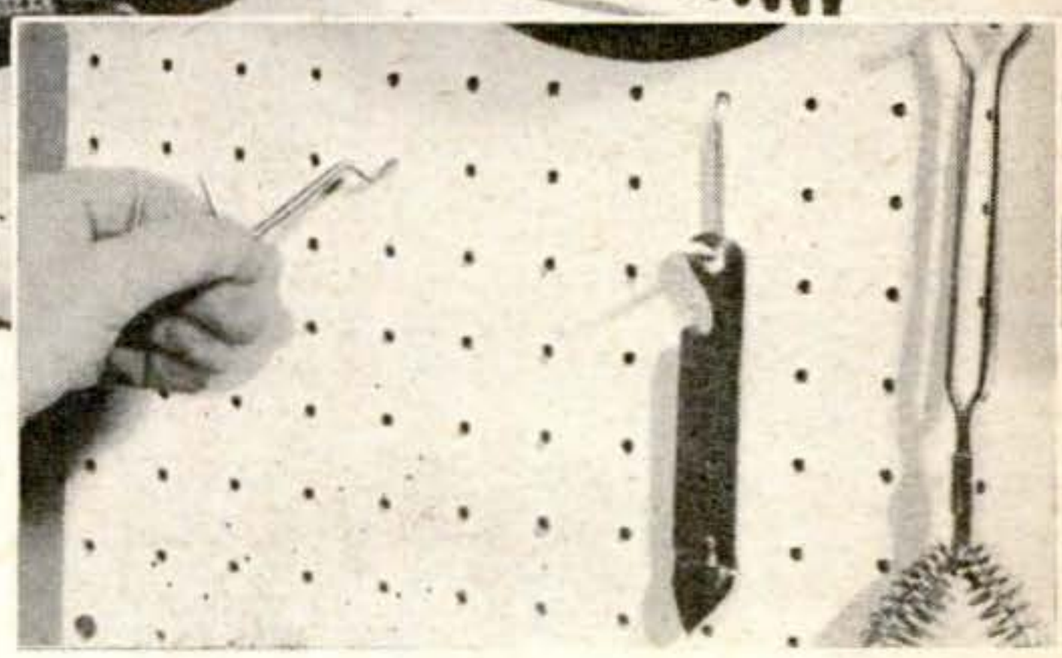
4. Recipe rack hung inside a cabinet door keeps favorite recipes always at the cook's fingertips.

5. Glue-on dispenser houses toothpaste tube, delivers a brush-length ribbon of paste when lever is pressed.









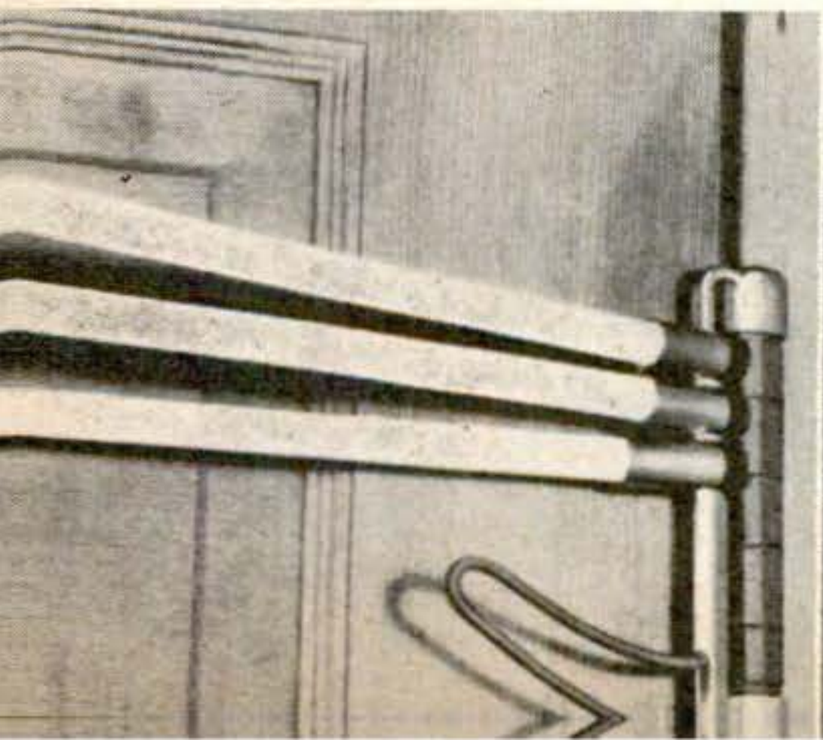
2. Peg 'em up—and kitchen or shop tools are always within reach. The 20- by 23-inch Peg-Board comes with 24 hooks and four spring clips. Hung on a closet wall, it will hold bags, belts, even shoes.

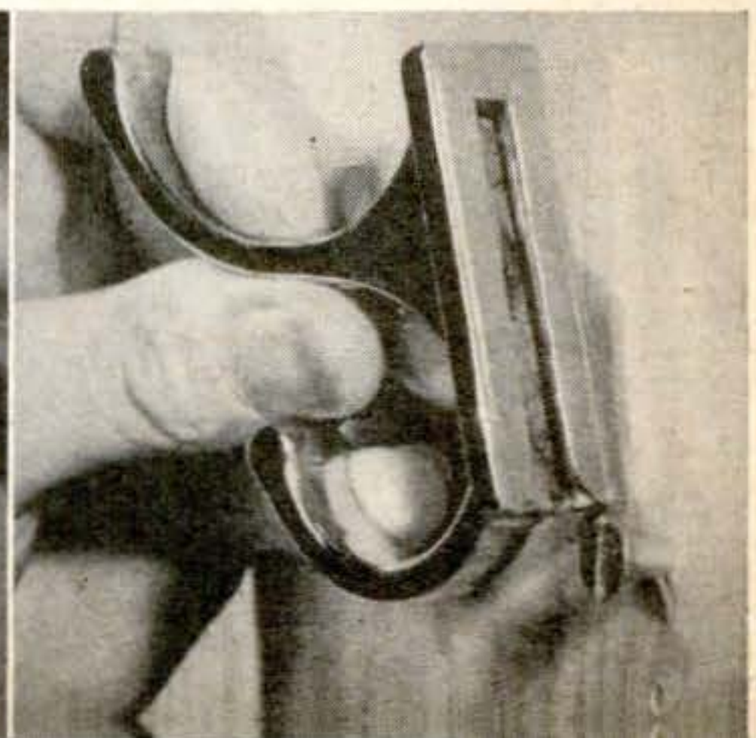
Further information on these products can be obtained from: 1. Pittsburgh Plate Glass Co., Pittsburgh; 2. Peg-Board of New York, 131 East 64th St., NYC; 3. Kinox Co., 103 Wales St., Rutland, Vt.; 4. Geneva Modern Kitchens, Inc., Geneva, Ill.; 5. Mid-State Products Co., 1940 East 6th St., Cleveland; 6. Palmer Products, Sexton Bldg., Minneapolis; 7. Apsco, Inc., 17 James St., Bloomfield, N. J.; 8. Continental Hardware Co., 539 Overbrook, S.E., Grand Rapids 7, Mich.

6. Clamp-on rack fits over any six-inch door hinge, gives you extra space for storing or drying clothes.

7. Tilt-up dispenser for detergent, hand lotion or shampoo is plastic, screws into adhesive-backed swivel mount.

8. Slotted hook slides over—and hides—mounting screws; lifts off, to protect chromium finish, when room is painted.



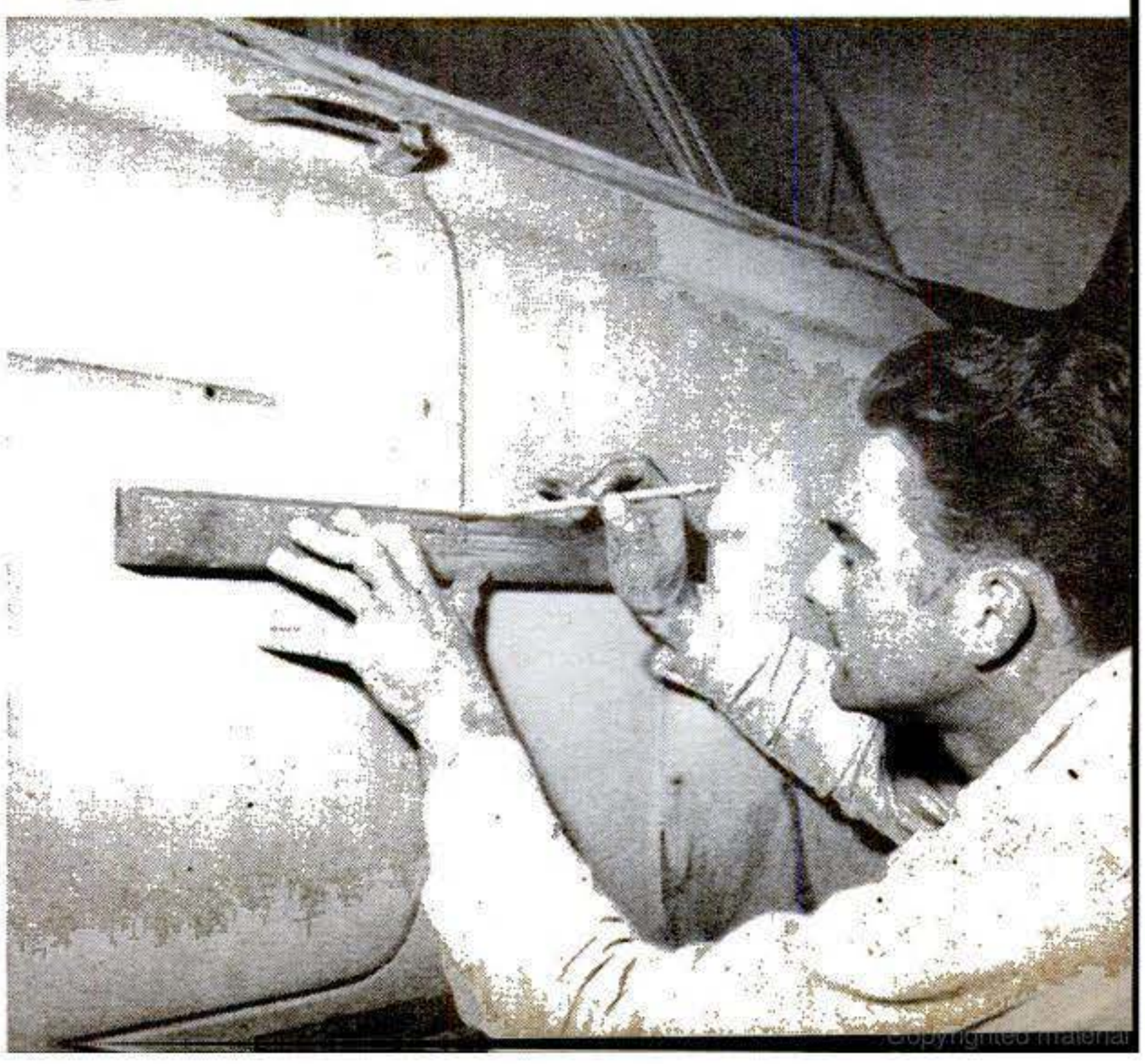


They Take Over Where

THIS HARD-TOP CONVERTIBLE really converts. Three men can lift the new Cad-DeVille top off Merc convertible body in spring, attach it again in fall. It is fastened to original front bow, latched down at rear where 14 inches were added to deck. Merc nose is shaved.

DROPPING BODY but keeping original design is specialty of Neal Emory, left, and Clayton Jensen. First step in slicing five inches from body is using plumb to find widest point of car, which becomes center of cut.

CENTER OF CUT is marked along door panel, using a level. Doors and various supports must be cut so slice can come out all the way around car. Sometimes the seats and floors must be dropped as well.



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Detroit Leaves Off

Two handy ex-GIs have made a flourishing business out of turning run-of-the-line cars into one-of-a-kind eye catchers.

By Andrew R. Boone

A COUPLE of fellows in Burbank, Calif., are making a pretty good living hacking up new automobiles. They take blowtorches and metal cutters to the bodies and the owners not only approve of it, they pay for it.

Neal Emory and Clayton Jensen are in the business of cutting automobiles down to size—the size the owner wants. They make 'em longer, shorter, smoother, fancier—but mostly they make 'em lower. A car owner drives in to their Valley Custom shop and says, "Make her look different from those squares coming off the Detroit production lines."

The partners oblige on anything from a '33 Ford to a '53 Caddy. When they get through, a car often looks much as it did before, except that it is squeezed down to a midget's line of sight.

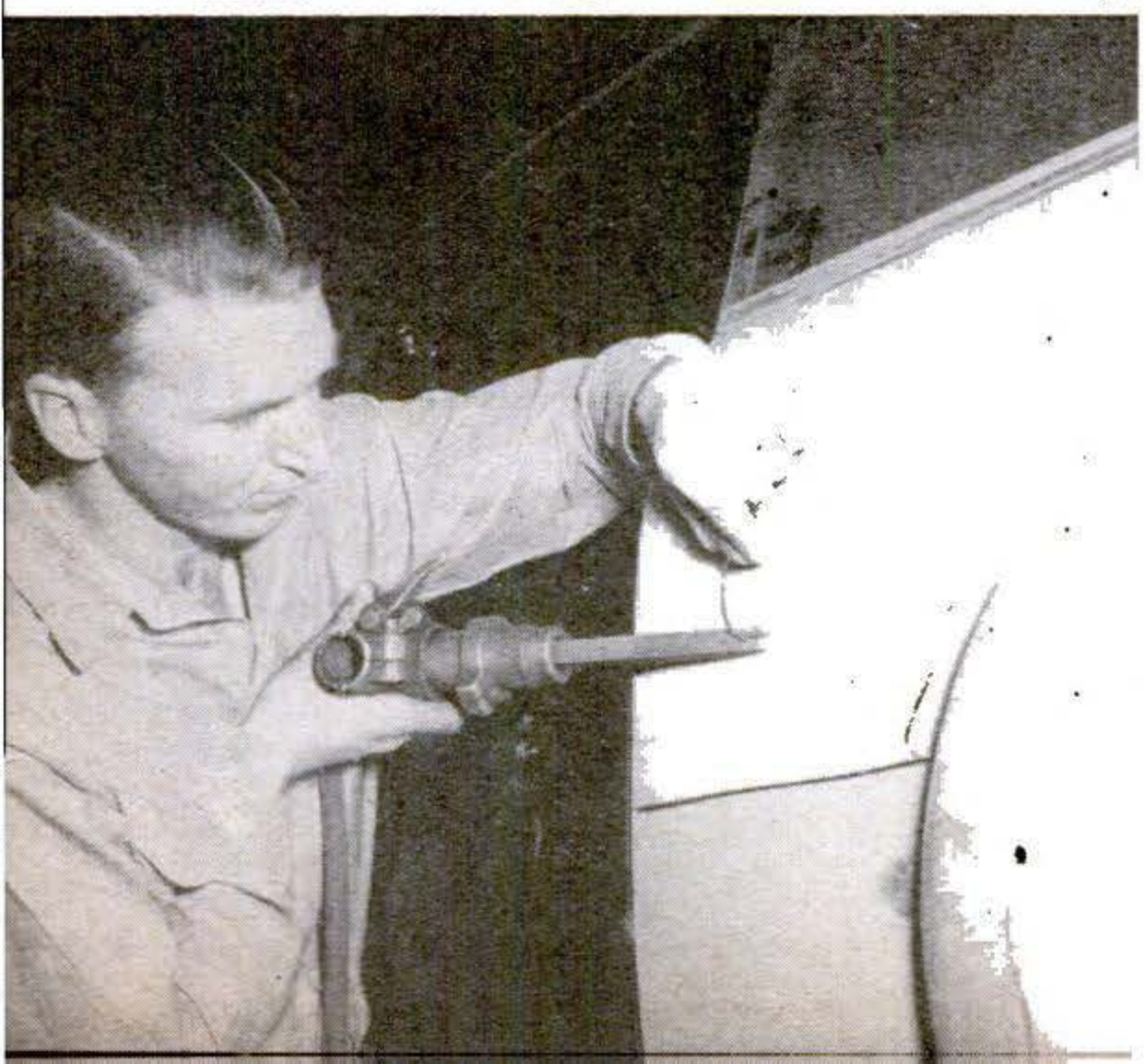
From the beginning, the partners have stuck to one formula: "Do the job as they would in Detroit, if their engineers sought the same effect. Keep the original proportions. Don't hide poor contouring under a blanket of lead. Turn 'em out so they look good from a distance, but even handsomer close up."

As a result, Valley Custom's eye catchers have won show prizes and brought more business than the partners can handle. They also have turned out some record-shattering hot rods.

For the guy who wants to do the work himself they've cooked up a special body-lowering kit.

The partners discourage customers from visiting the shop during the early stages of a teardown. They figure an owner might get apoplexy if he saw them rip out a strip of sheet metal clear around the body or tear out the insides.

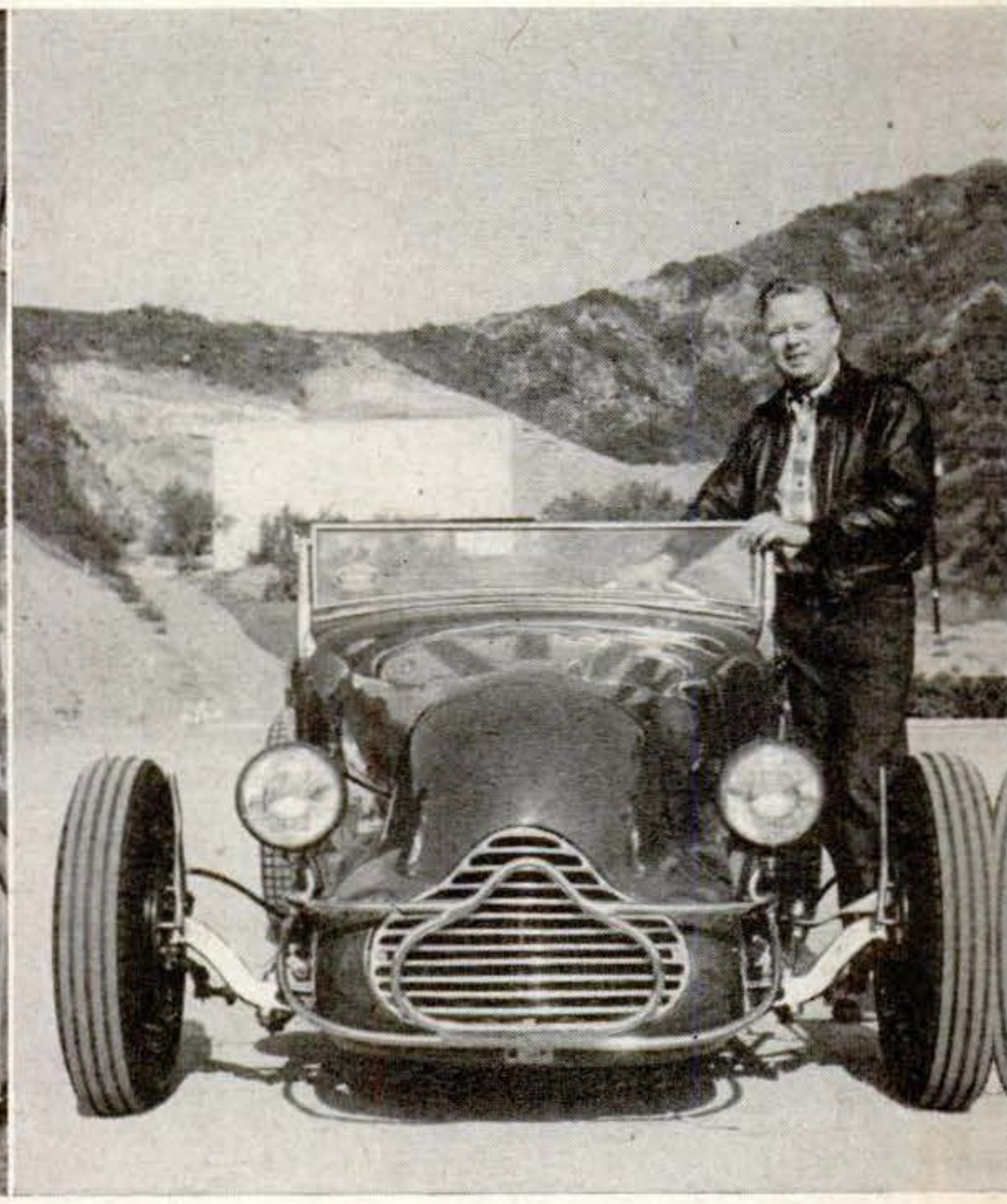
METAL IS SLICED OUT along five-inch strip with air-driven cutter. Most radical job done by shop was bringing down the top of a '41 Ford 18 inches while keeping six inches' road clearance. Partners trimmed bottom of body.



FIVE-INCH STRIP is peeled off section by section. After the two halves are welded together bead is torched and hammered flat against bucking bar. Then the surface is ground and filed smooth. *Please turn page for more photos.*

RECOGNIZE IT? This traffic-stopper began life as a '51 Plymouth custom convertible. The front end, which resembles a new Chrysler V-8 installation, was made from two Plymouth '51 grilles to give a massive effect. Note how the painted panel under the bumper hides the running gear and helps give the conversion a low look. Partners Emory and Jensen believe that conversions should be functional and comfortable, with plenty of headroom and clearance for rough roads, but they give the customer what he wants. On late-model cars they sometimes lower coil springs 2½ inches with a patented arm that raises spindle.

SOLENOIDS for an electric push-button door lock are installed by Clayton Jensen in a fancy job. A full custom conversion—sectioning, cleaning up, channeling, lowering and sometimes camouflaging—may run to $5,000. Majority of customers want semi-custom job—mostly removing ornaments, chrome.



THIS 143-M.P.H. SPEED WAGON for dry-lake racing was once a Model A roadster. Now it really looks like a competition job, and houses a '40 Merc engine. Louvers in top of hood help cooling. Tubular bumpers were designed by owner Dick Flint of Glendale, Calif. Car interior is finished for town use.

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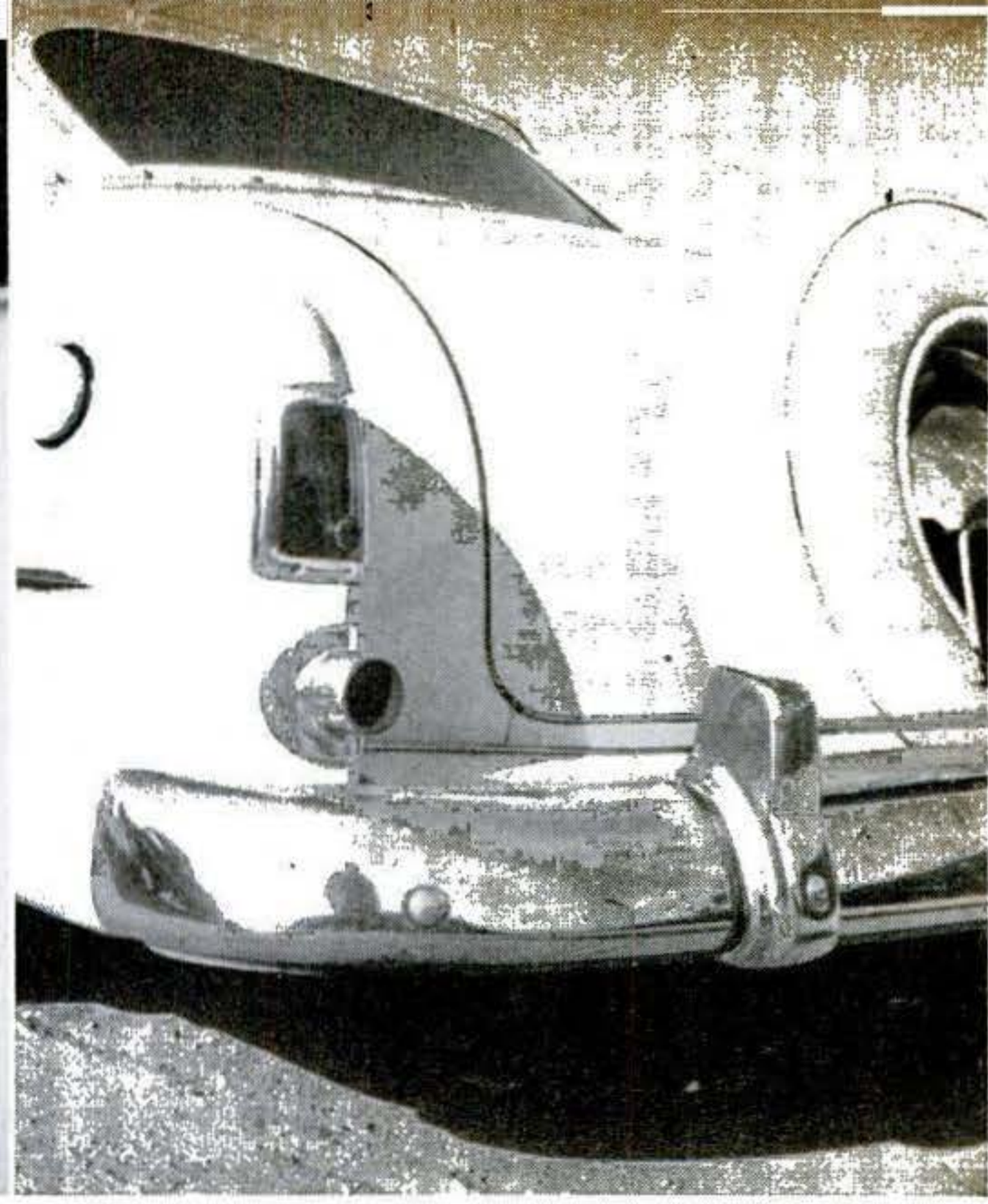
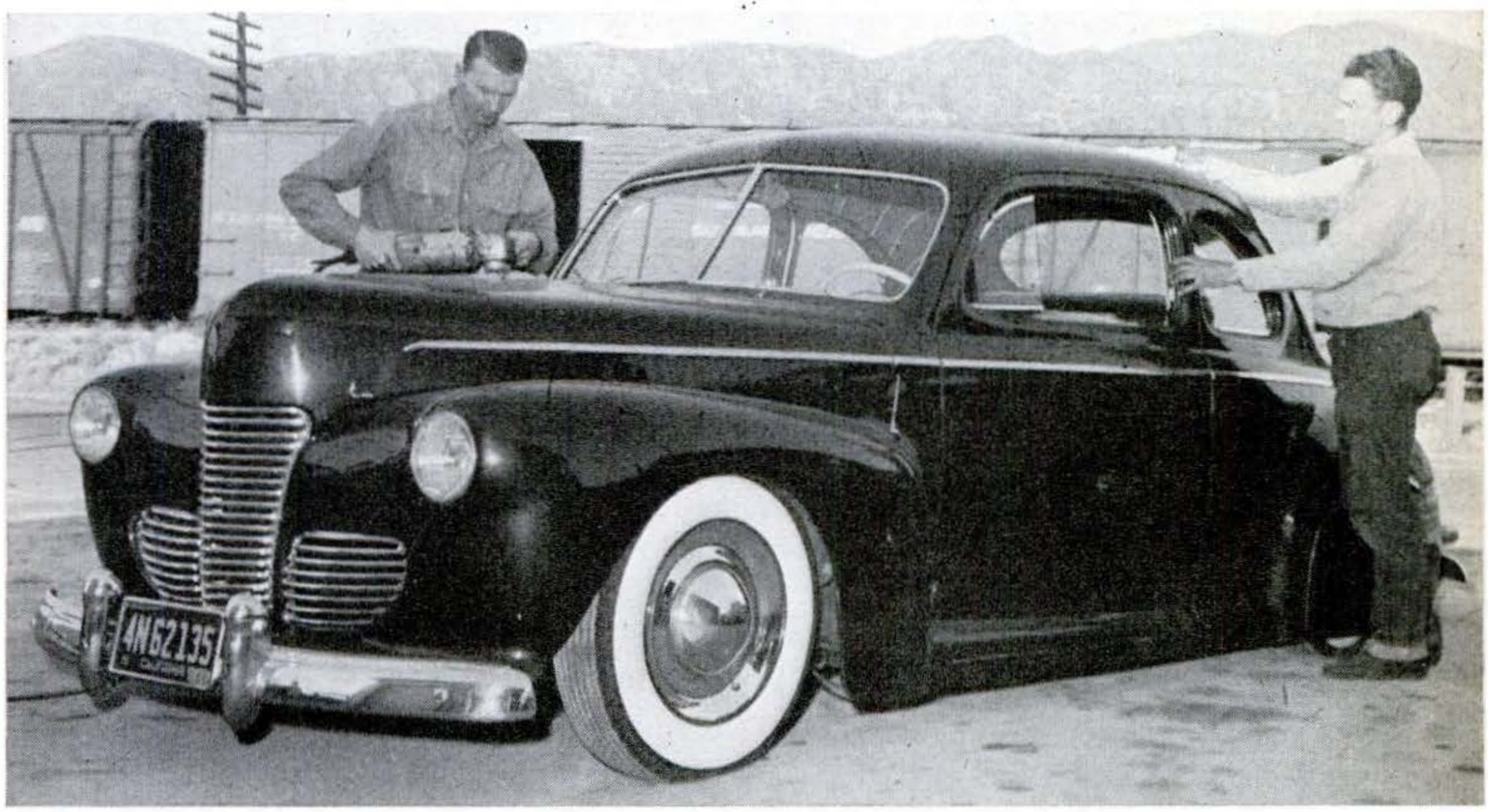
STRAPS AND CRASH PAD have been added to Plymouth's interior for safety in fast driving. During five years in business, Jensen and Emory have made major or minor conversions on nearly 1,000 cars. Occasionally they sketch a design, but only for customer; details are worked out in their minds.



EXHAUST PIPE extends through fenders above bumper on converted '51 Plymouth. Rear fenders are '51 Chrysler, altered to fit. Longer fenders and continental spare-wheel kit make the Plymouth look longer and larger. Partners emphasize smooth metal work, say best lacquer coat can't hide a bum metal job.



JOB DONE, partners give final polish to a low-down '41 Ford coupe. With zeed frames, car has only three-inch clearance, which limits it to smooth highways. Customizers removed and welded over 20 seams. Butterfly grille gives final swank touch to nose. Besides custom and semi-custom jobs, partners figure on two main types of conversion. Hot-rodders want racy appearance to match their souped-up engines. And owners of foreign cars usually want them made lighter for racing. Partners, who are married to sisters, work like mechanical twins; both contribute ideas, either can pick up a job where other leaves off. END

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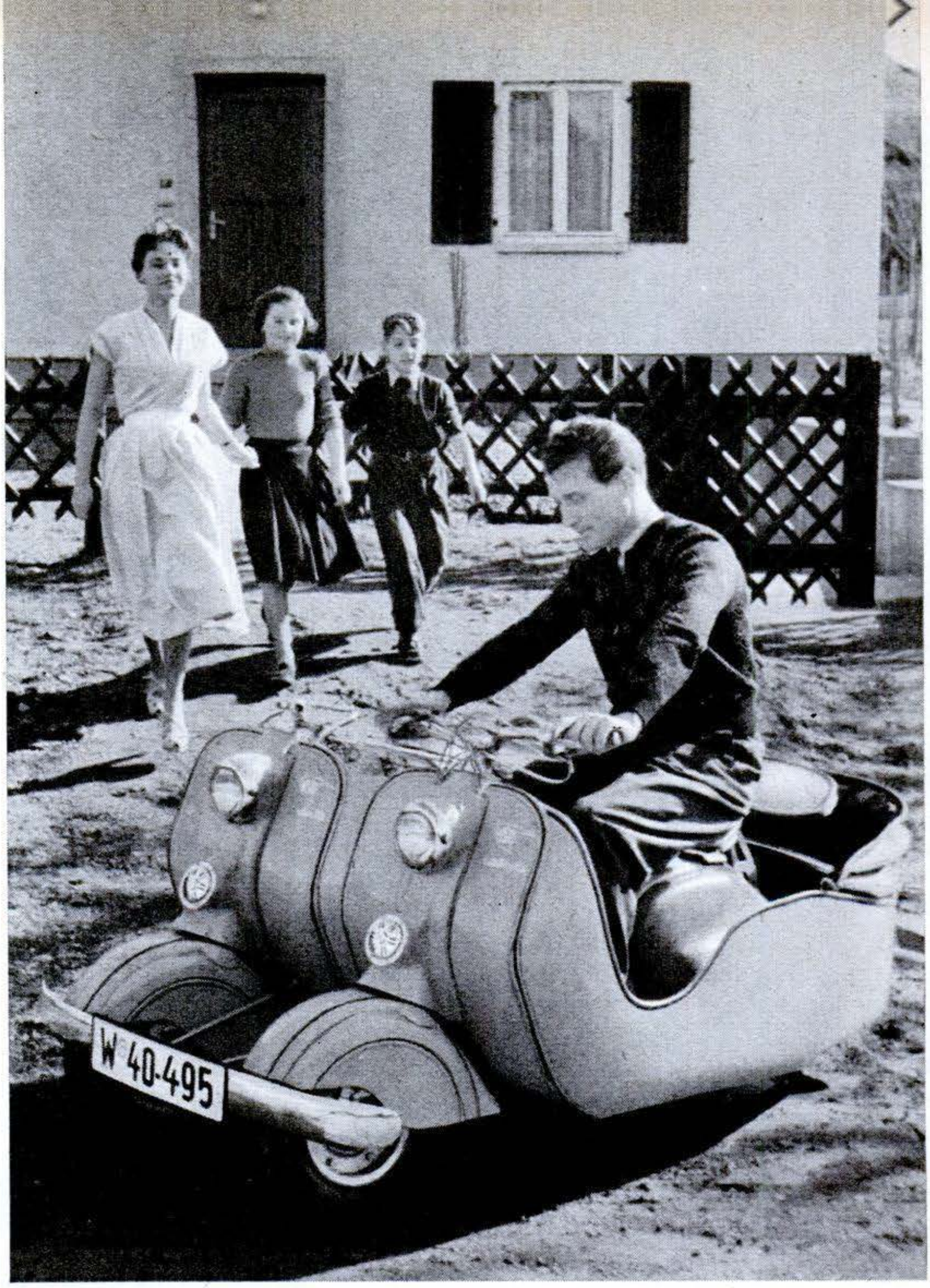
It's a Joke, Son

WHEN the boys at the NSU Works in Neckarsulm, Germany (motorcycles, bicycles), work up a gag, they go about it with the methodical planning that Teutons are noted for. "A good technical joke," they say, "must be nonsense—but still on the border line of reality."

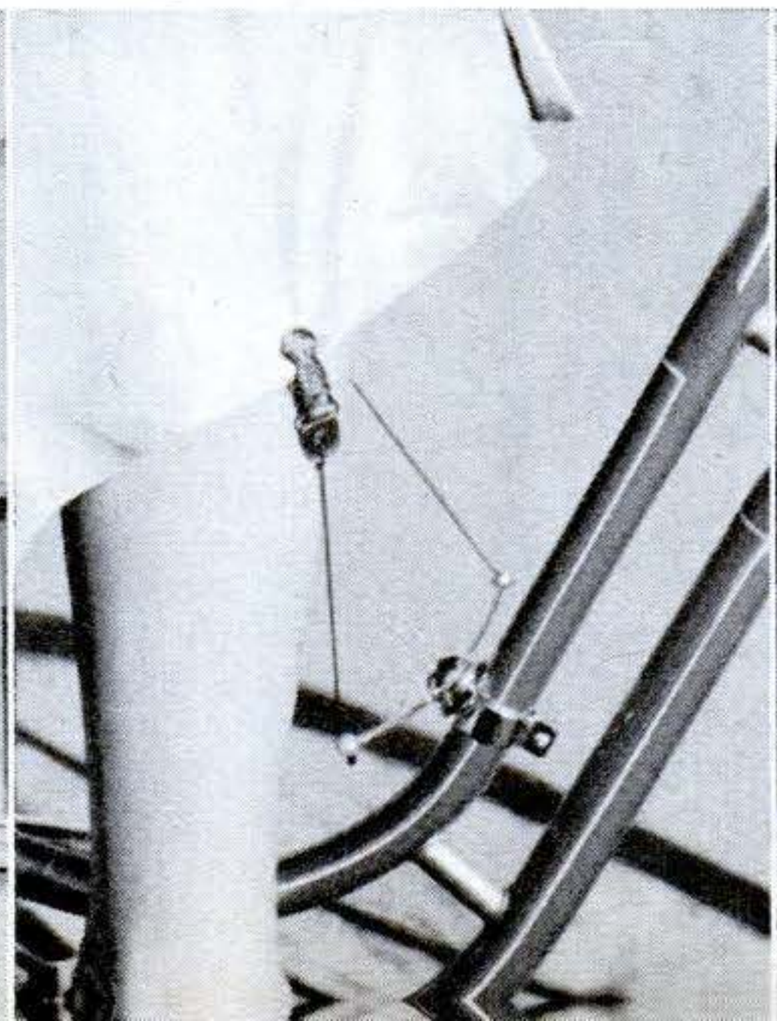
How well they succeeded is shown by the pictures on this page. All four "new products" are strictly for fun, not for sale. But they look so reasonable that PSM editors were marveling at the fresh, though wacky, imagination of German designers—until translation of an obscure section of the German captions gave the joke away.



DOUBLE SCOOTER, the NSU jokesters claim, solves an old problem for the cyclist whose expanding family needs a four-seater.

MOTORCYCLE FIRE ENGINE, presumably for small fires, even has its own engine-driven pump to squirt water.

SKIRT HOLDER protects modesty of girl bicyclists on breezy days. The user would have to unclip it to leave the bike.



REMOVABLE MOTORCYCLE ENGINE runs saw through flexible shaft. Also recommended for powering a floor polisher.

"I Flew with Our Radar Scouts"

By Herbert O. Johansen

The Navy's new aerial weapon carries no bullets, rockets or bombs. Come along on a flight in this electronic mastermind.

A HALF-HOUR before midnight we file into the briefing room carrying steaming mugs of coffee. Rain beats against the windows and the howl of a high wind penetrates the hangar of AEW Squadron VW-2 at the Naval Air Station, Patuxent River, Md.

Pointing to a chart on the wall and circling an area over the Atlantic off northern Florida, the operations duty officer begins, "Weather in the operational area is marginal instrument with heavy seas."

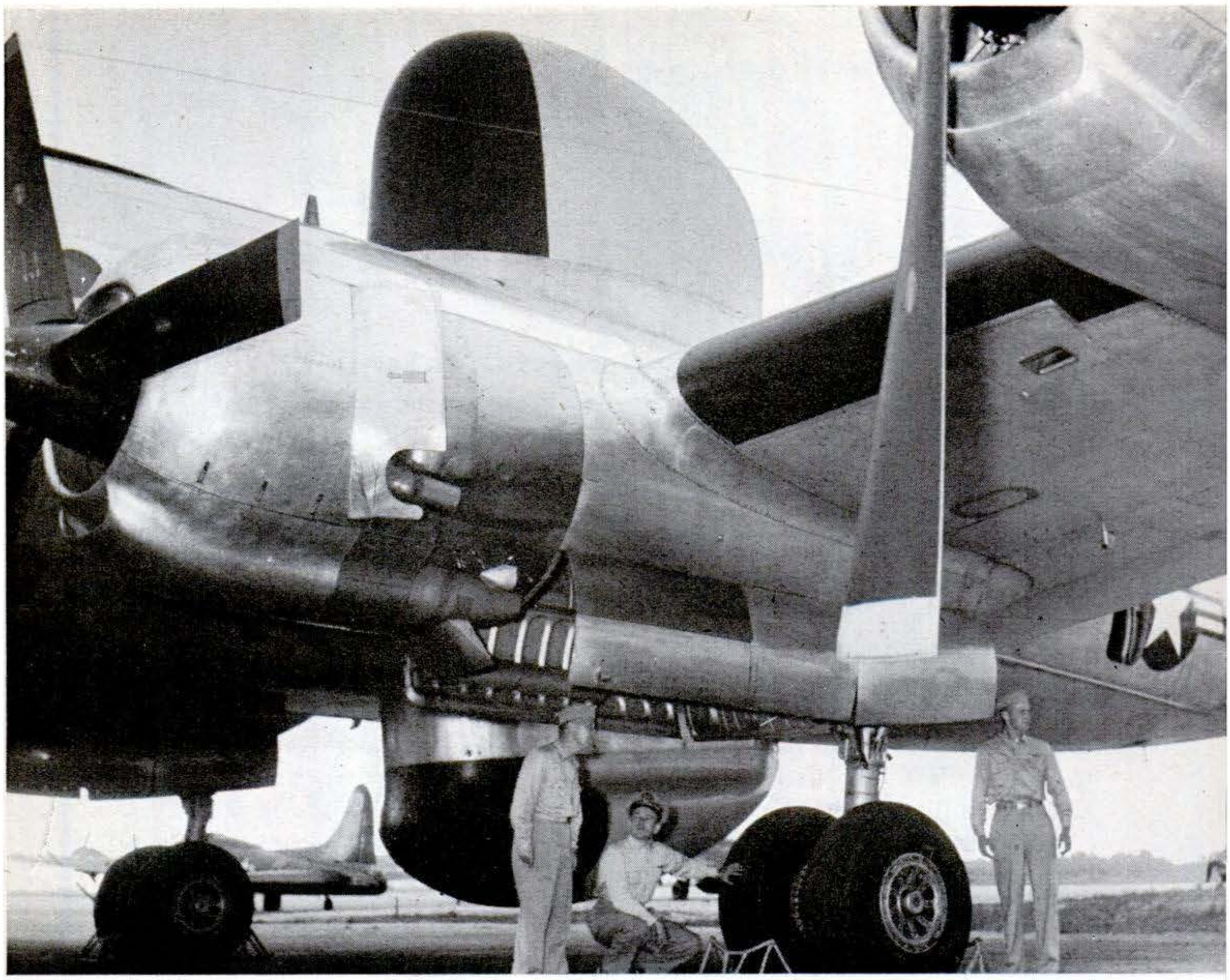
Our mission is to relieve an airplane on station and fly an AEW (Airborne Early Warning) radar barrier patrol for a fleet task force making its way up the U. S. east coast for an attack on "enemy" forces at Cherry Point, N. C.

The briefing officer gives the position of the task force as 365 miles east of Jacksonville. Two hours before sunrise the carriers *Coral Sea* and *Franklin D. Roosevelt* will launch air strikes against black (enemy) shore targets. Enemy air attacks from shore are expected.

Coffee mugs are drained hurriedly and we file down the stairs, through a hangar door and out into the wind-whipped downpour.

There are 32 of us, including three pilots, two navigators, eight CIC (Combat Information Center) officers and controllers, two electronic countermeasures officers, two radarmen, two radio operators, two flight engineers. But there is only one plane for all of us—a triple-

SEVEN BAYSIDES TAKES OFF—more than 50 tons and $6,000,000 worth of plane and electronic equipment.



THE AEW CONSTELLATION bulges top and bottom with radomes. The top bulge houses antenna for height-finding radar, used for first time on this Navy air-fleet exercise.

tail, four-engine Constellation. It is silver-skinned like the commercial Connies you see at the airport—but with a difference.

On top of the fuselage is a large plastic hump housing the antenna for height-finding radar. From the belly protrudes another odd-looking radome, containing the antenna for the airborne search radar. The spine of the fuselage is saw-toothed with additional short, stubby radio antennas.

In the main cabin all resemblance to a commercial airplane ceases. It looks more like an oversize control booth of a television studio.

On both sides of a center aisle are several consoles with 12-inch radarscopes at the center of a complex of switches, dials, knobs and buttons. At each console is an upholstered swivel chair with a safety belt. Spaces in between are packed almost solid with electronic gear.

As the crew settles in take-off stations, I plunk myself down on the upholstered lower part of a double-decker bunk.

"Why not make yourself really comfortable?" asks a young lieutenant (j.g.). He pulls down the top bunk. It becomes the back of a living-room-like sofa. There are four of these.

He hands me a radio headset with an attached swivel microphone and plugs it in an outlet. I adjust the earphones as the j.g. flips a switch.

There is a crackling in the earphones. Then the pilot's voice: "Patuxent Tower. This is Seven Baysides ready for take-off."

There is a pause and the tower replies: "Roger. This is Patuxent Tower, Seven

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AIRBORNE COMBAT Information Center is a busy place when search radar picks up an "enemy" plane. Its location must be pinpointed to guide interceptors to the kill.

Baysides. Switch to Patuxent flight control when airborne."

"Who's Seven Baysides?" I ask my j.g.

"That's us," he informs me. "Our code name. You'll get more of them when we get out to the task force. The *Coral Sea*, the command ship, is Birch Tree, and the *FDR* is Small Fry."

Soon after we are airborne the CIC officer checks with the flight engineer for any signs of gas leaks or fumes. Only when he gets an all-clear back does he order the radar gear switched on.

The radarman adjusts his scopes and reports, "Radar okay."

With that, one of the CIC radar control officers tunes in his scope. As the sweeping arm establishes a clear picture of the terrain below on his scope, the navigator calls back for a radar fix.

The control officer identifies Elizabeth City, N. C., and marks it on his scope glass with a yellow grease pencil. Then he presses a button that makes a bright pointer line appear. This doesn't sweep around but can be moved by a knob to any position on the scope and fixed there. He moves the pointer line to connect the center of the scope (our position) and Elizabeth City. He next presses a button and the range (distance in miles) appears in a glass window on his right. He presses another button and the bearing in degrees shows up in a window at his left.

With this information he calls the navigator: "Elizabeth City now due south 120 miles."

"How about some coffee?" asks the j.g.

We follow the aroma forward to a chromium-shiny galley, complete with

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RADAR OPERATOR tunes equipment and maintains it so that controllers get best possible scope picture. Electronic circuits use 1,400 separate tubes of 300 different kinds.

THE AUTHOR takes a turn at tracking a blip on one of the radarscopes. It turned out to be one of our carriers. Man in foreground is operating the height-finding radar.

electric grills, hot plates and a sink with running water. A pot is perking merrily. Across the aisle, under the navigator's table, is a small electric refrigerator.

"We can feed the whole bunch in 45 minutes," my lieutenant informs me proudly. "When we have steaks it takes a little longer."

"Glad to have you aboard, Mr. Johansen," says a voice at my elbow. "Mind if I join you?"

I recognize Commander Harry A. Rowe, skipper of AEW Squadron Two. The CIC compartment, which takes up the greater part of the fuselage, is as dimly lit as an off-street night club.

Skipper Is Veteran Pilot

The 39-year-old skipper is a veteran pilot and an authority on electronics and air defense. In 1944 he was Air Defense Force Director of Admiral John McCain's famous Task Force 38 in the Pacific.

AEW, Commander Rowe explains, was born of necessity during the latter part of World War II in the Pacific. Because radar operates on a line of sight, Jap planes were able to sneak in at low altitude without being detected until it was too late. That's the way a single Nip bomber put the carrier *Franklin* out of commission. This same low-flying, radar-evading tactic was used by Jimmy Doolittle when he attacked the Japanese mainland earlier in the war. And it is a tactic that could be used by an enemy against the U. S. mainland today.

There is a limit to how high a radar antenna can be placed on a ship. The obvious solution was to elevate the antenna by placing the radar in an airplane. Late in 1944 a powerful, million-watt, but small and lightweight radar unit, developed by the Navy and the Radiation Laboratory of MIT, was put in a belly-bulging Grumman Avenger. It was first called the Guppy, later Cadillac I, because it was first tested on Mount Cadillac, Me.

The trouble with Cadillac I was that it couldn't be kept in the air long enough and its radar wasn't "ground-stabilized." The scope information that the pilot relayed to the carrier didn't take the wind or speed and drift of the airplane into account.

Flying Fortress Picked for Job

One solution was to take a CIC unit out of the carrier and put it up there in a plane with the radar to evaluate the scope information and to direct fighter interceptors to their targets from the air.

That called for a larger aircraft. A B-17 Flying Fortress was picked for the job. Then the radar equipment was improved by adding circuits that enabled the navigator to feed in electronic compensation

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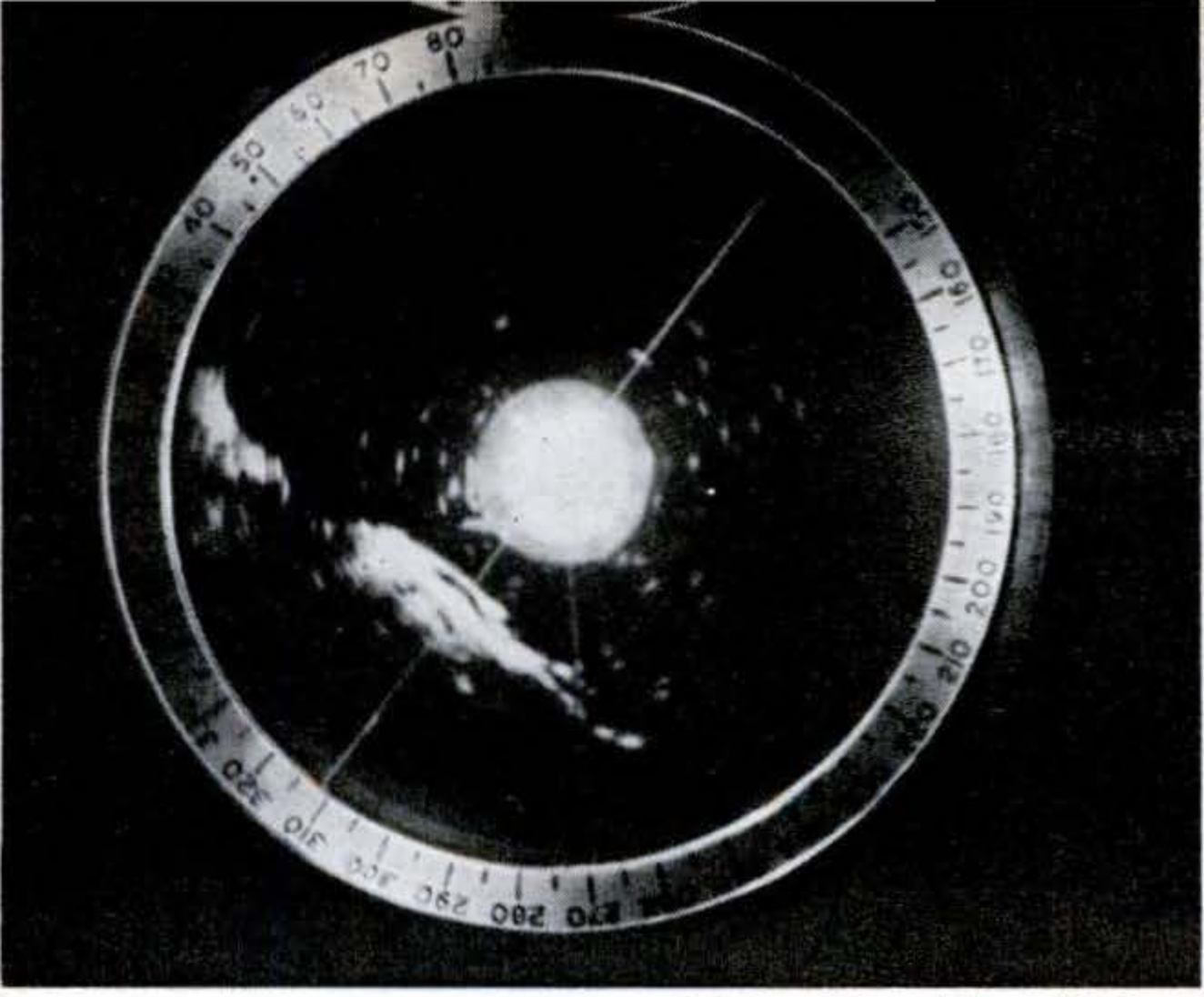


RADARSCOPE PICTURE looks like this. Light areas at lower left are shore line. Blips around center spot are ships and planes. Movement of a blip indicates an aircraft.

A RUNNING PICTURE of what the radar "sees" is transferred to a chart. Electronic plotting computers are being installed in the new AEW Super Constellations now in production.

for speed, drift and wind. Twin repeater scopes were installed and their pictures from the master radar were the same as if the equipment were on the ground, anchored in concrete. That was Cadillac II.

Next came the Connie we are flying—Cadillac III. On the way is still another new Cadillac—an AEW version of the Lockheed Super Constellation. It will be larger, faster and, naturally, have more and better radar gadgets.

Radar Picks Up Task Force

The CIC officer interrupts Commander Rowe to announce that the task force has been picked up on the radar. We walk down to his position, which is amidships on the port side, facing out. I lean over and see that as the arm sweeps around the scope it brings out a group of bright pips in the lower right section. That is the task force. The CIC officer had outlined the positions in yellow grease pencil. He brings his pointer line into play, positions it and presses the range button. In a window at his right appears the distance in miles—well over 100.

"How do you know those pips are the task force?" I ask Commander Rowe.

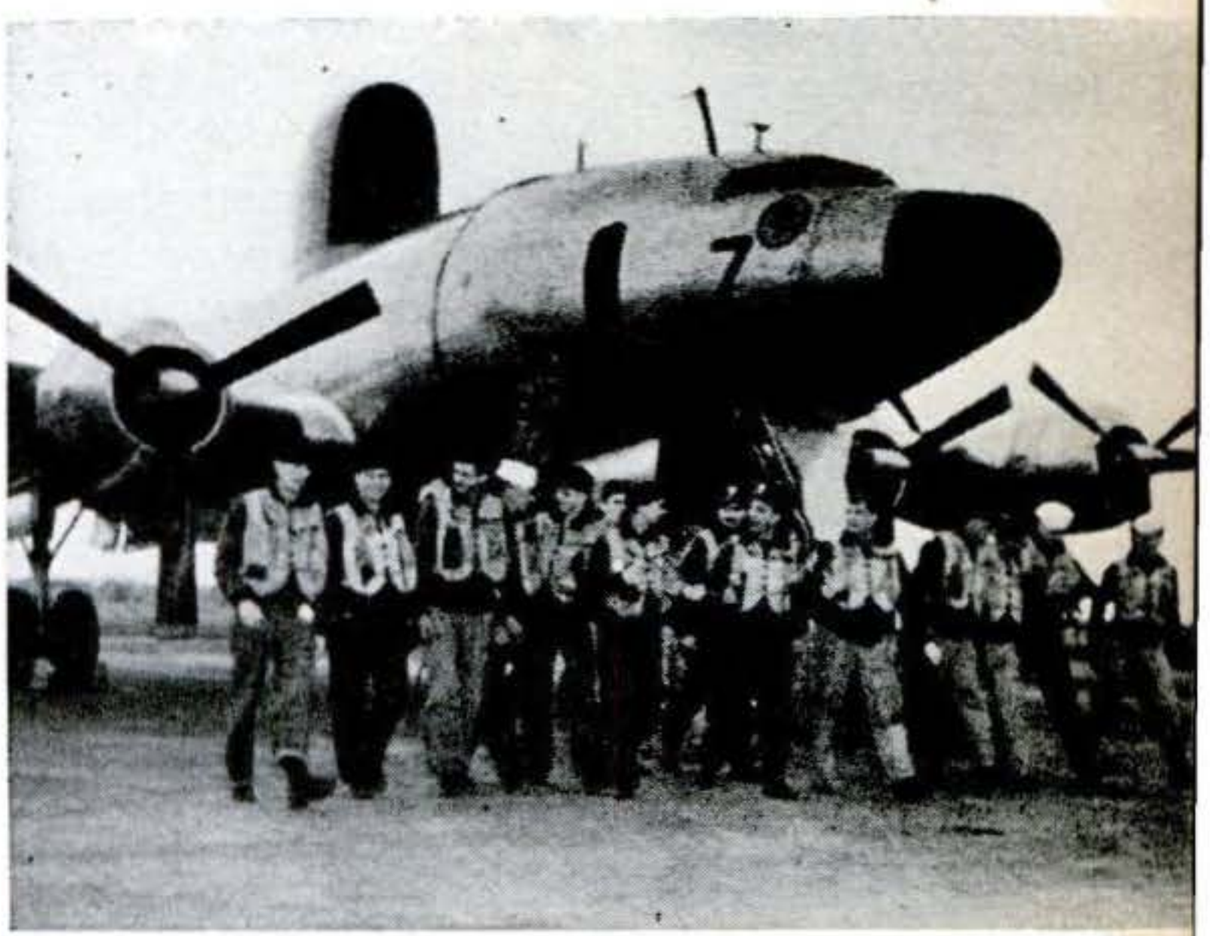
"Experience plus information. At our briefing, you'll recall, we were advised of the location of commercial shipping in the area and also of the location and number of ships in the task force. And if you look closely you can count 13 individual pips in the group."

"But maybe they're airplanes?"

"No. That's one reason why pips are circled on the glass with the grease pencil. As the radar sweep arm swings around, you'll notice that the pips don't move. If they were planes, they'd have moved outside of the grease-pencil circle by now. And, incidentally, it's by checking the rate of movement of a pip that we estimate the speed of a plane."

That took us to the console of the electronic countermeasures officer, who

[Continued on page 240]



SEVEN BAYSIDES RETURNS from a 17-hour barrier-patrol mission. Other jobs of AEW are submarine hunting, and tracking hurricanes to give cities advance warning of danger.

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One Man Can Hitch Up Tractor

WITH this hitch, a farmer can back a tractor up to any implement and lock it on behind without leaving his seat. It lifts and grips a bar on the tongue of the implement. A pull on a cord frees the tractor. Alprodco, Inc., Kempton, Ind., makes the hitch.

Magnets Hold Chessmen

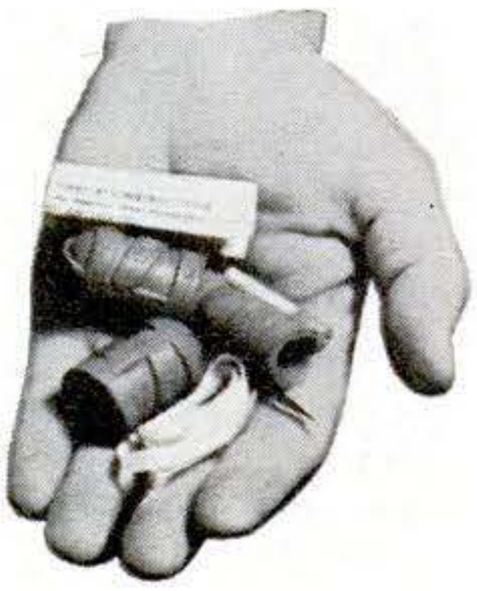
TINY magnets hidden in this chessboard keep metal playing pieces from skidding if the board is tilted or joggled. Designed for fans who like to take their favorite game along when traveling, it was exhibited at a German leather-goods fair.

Flies Trapped in Labyrinth

BAITED with a piece of raw meat, the trap at left lures flies and bees down a twisting tunnel into the jar. Once inside, insects can't find their way out and a bit of insecticide at the bottom of the jar kills them. The Myon Products Co., Los Angeles, makes the Fly-Trap for use in barns or just outside the house.

Snake-Bite Kit Fits Pocket

HERE'S everything you need for first aid in snake country. Tape for stopping circulation, knife and vial of antiseptic pack into rubber suction cups that remove venom. Cutter Laboratories, Berkeley, Calif., makes the kit.



She's a Tire Sculptress

ADD odd jobs—sculpturing tire treads. June Adair (above) works on raw clay molded over a wooden form. From this, Firestone makes plaster casts, then metal molds.

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Toy Car that Really Runs Runs into Parking Trouble

JOHN LAW could put the arm on this youngster for illegal parking near a fire hydrant, or even for dangerous driving, because this tiny plastic car actually runs. But six-year-old Brian Dunne will never have to worry about tickets for speeding. The 62-inch-long car runs on power from a six-volt battery and travels at only five miles an hour. Designed to give a child the thrill of driving at a safe speed, it was shown at the American Toy Fair this spring. Junior can own one for $500.

They Say Now.....

"The success of the scientific method in practical matters has depended upon the rejection of pure reason as the court of last resort, and the substitution of observational tests for logical tests."—MAURICE B. VISSCHER, UNIVERSITY OF MINNESOTA PHYSIOLOGIST.

"The nation that wins the next war will be the nation that develops alloys for use at high temperatures."—ROBERT F. MEHL, CARNEGIE INSTITUTE OF TECHNOLOGY.

"Some day, even in peacetime, the nucleonics industry will be bigger than the iron and steel industry."—ZAY JEFFRIES, VICE-PRESIDENT, GENERAL ELECTRIC.

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How Gas Gauges Work

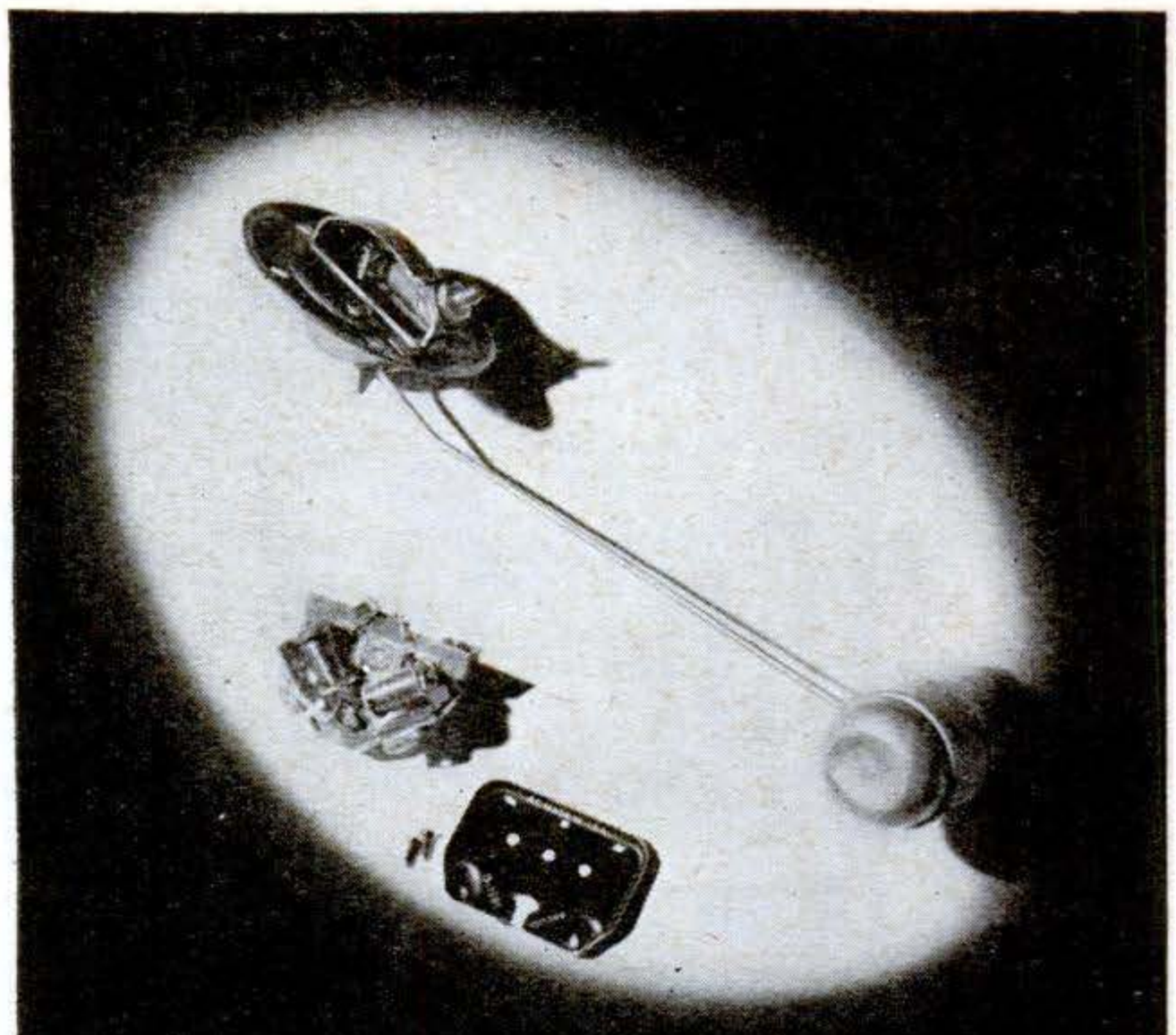
Dashboard robots strain to give you accurate fuel-level readings from "E" to "F."

BUSY midgets make your fuel gauge work. In some makes of car two of them flex magnetic muscles in a tug of war that tilts the indicator needle. In others the midgets squirm uncomfortably in electrically heated jackets, while clinging to the pointer for support.

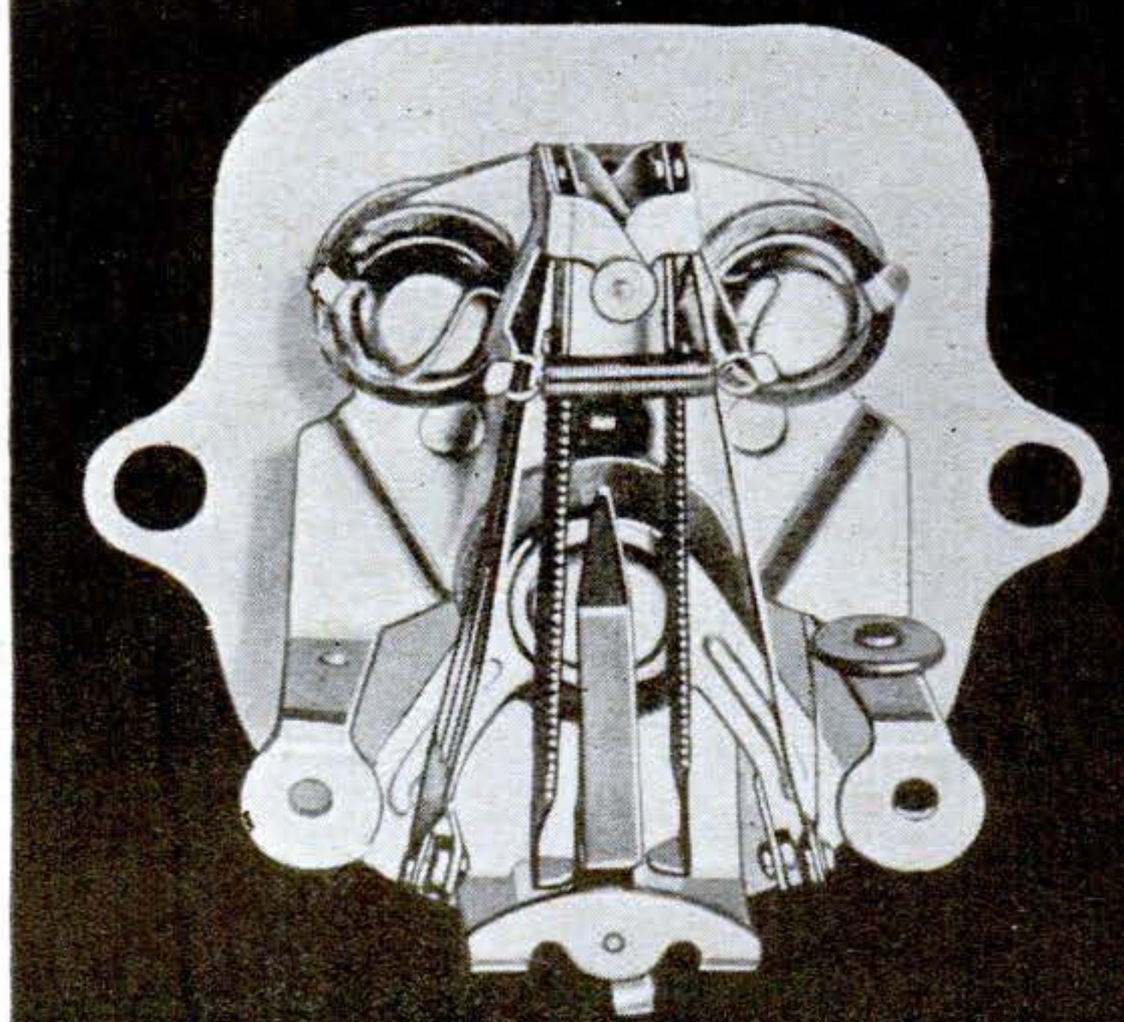
Whether your car uses the balancing-coil type of gauge or the thermostatic type, the behavior of the midgets is governed by a cork float which rests on the surface of the gasoline at a point near the center of the fuel tank.

The up-and-down action of the float is passed through a wire arm to a sending unit in a small box. This sending unit may be a rheostat or a cam, depending on the type of gauge and the manufacturer. In either case its business is to transmit electricity to the dashboard unit. In the balancing-coil type it decides which of the two magnetic midgets is to win the tug of war with the pointer. In thermostatic gauges, it makes the two coil-heated midgets bend the exact distance needed to give an accurate fuel reading.

The two drawings on the opposite page show just how the midgets say: "Brother, it's time you headed in for gas!"



TANK AND DASHBOARD UNITS of a balancing-coil fuel gauge. Today's low car bodies call for shallow tanks, making it more and more difficult to design accurate gauges. The sending-unit box is often mounted below the top of the tank to gain trunk space. A stop prevents the float from touching bottom, giving a margin of safety when the pointer shows "Empty."



VARIATION of the thermostatic gauge shown on the opposite page is this dashboard unit, which uses one coil-heated bimetal blade to swing the needle toward "Empty," another to move it toward "Full." A rheostat in the sending unit increases flow of current to the right-hand heating coil when the float rises, while reducing flow to the left-hand coil.

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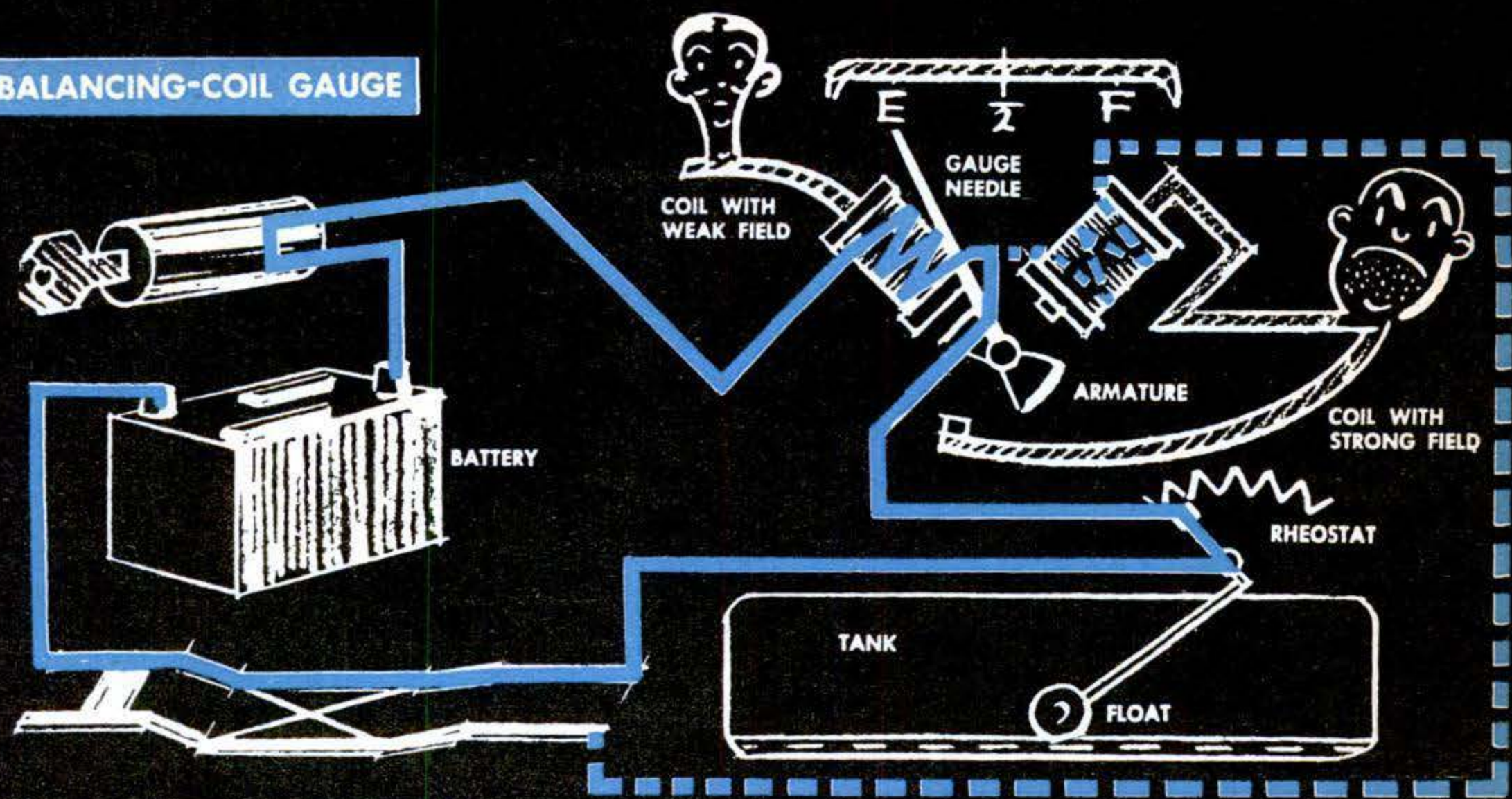
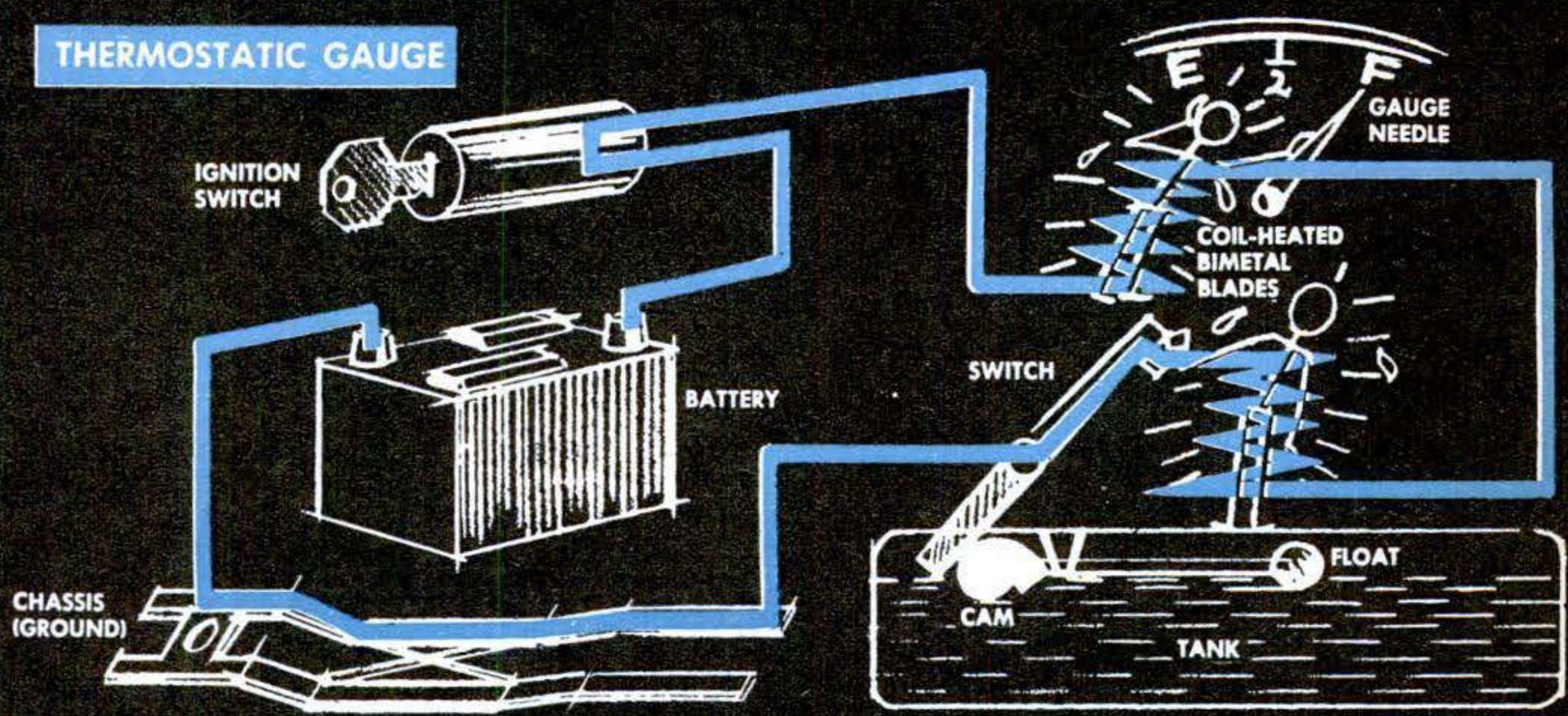
BALANCING-COIL GAUGE



BALANCING-COIL FUEL GAUGE has two small magnets back of the dial. The one at the right is stronger because it has a longer core extension. When the ignition is turned on, two electric circuits are set up—one to feed each magnet. If the tank is empty, the float arm cuts out a rheostat, and all current goes to the left-hand magnet, pulling the pointer to "Empty." When the fuel level is raised the float cuts in the rheostat, making it harder for juice to pass through the left-hand magnet. More and more current flows to the right-hand magnet, and the pointer swings toward "Full." Rotation of field force—not the strength of the current—produces the reading. That is why the gauge is consistently accurate, whether the battery in your car is fully charged or weak.

THERMOSTATIC GAUGE



THERMOSTATIC GAUGE goes to work when you turn on the ignition, sending current through two coils of resistance wire, each wound around a bimetal blade. The blades are identical, and bend equal distances when heated by the coils. To make the bimetal twins show the right fuel level, one is placed in the tank's control unit and the other in the gauge. As the float rises, a cam moves a lever against the tank blade, bending it the right distance for an accurate fuel-gauge reading. The tank blade won't bend further until heat has warped its twin in the gauge to the same position. Since more heat would make both blades go on bending, a switch opens every time the tank blade breaks away from the lever, returning both of the blades to their right positions.

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Earthquakes Are His Hobby

West Coast engineer builds his own seismograph to keep tabs on the world's lively pulse—and shows you its shakes while you wait.

By Harry Walton

FRED ROBINSON, an engineer for a utilities company, keeps his hobby going 24 hours a day. His private seismographic station on Point Loma, overlooking San Diego Bay, takes the earth's pulse day and night.

Robinson's instruments may break into furious activity any moment. An automatic alarm attached to his seismograph sometimes rouses him from bed. But if you think there's nothing doing between such high spots, walk into his workshop-lab any evening.

The most prominent thing in it is a steel pyramid about six feet high, but your eyes are drawn to a small panel board on which a red lamp glows. It's labeled *West*. An electric meter beside it shows current flowing.

"That's not a quake," he explains. "The mountains are cooling off now, and the contraction pulls the crust that way."

The ground suddenly seems a bit less solid underfoot.

"Watch the other lamps," says Robinson, and you stare at the five unlit ones.

Just before you get restless, another lamp flashes. The meter needle quivers.

"That's a very minor movement south of here," you are told.

Near the tower, in a glass-topped case, a recording drum turns slowly under three pens. Any quake above a very low intensity shows as a jiggle of the straight lines. Remembering how hard it is to write if the paper slides under your pen hand, you may wonder how, with the very ground moving underfoot, either drum or pen stays put while the other forms the jiggles.

Inertia Does It

Mounted near the tower on long spring leaves are two tiers of storage-battery cases filled with metal slugs. Because of their mass and spring mounting, the cases

Light Gun Does NOT Rest on User's Nose

A LIGHTWEIGHT machine carbine, being considered for use by the British army, is demonstrated at Hythe, England, by T. A. McCluskey, sergeant-instructor. Known as the Patchett gun, it looks as though it were resting on the user's nose. Actually, the weapon has a collapsible stock that is snugged against Sgt. McCluskey's shoulder. The new gun is being tested at Britain's infantry school.

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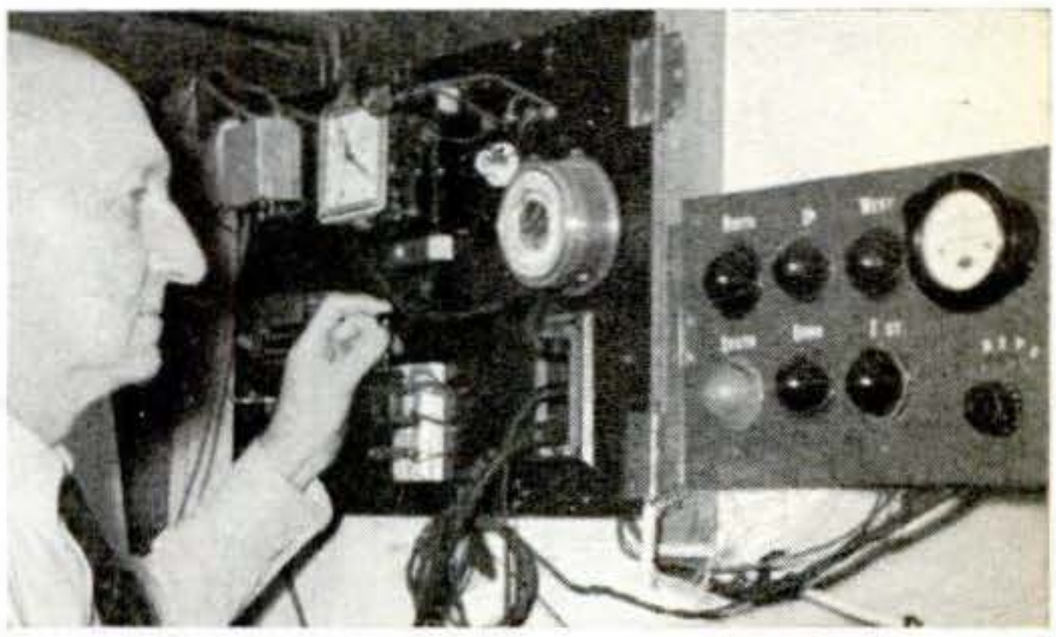
CLOCKWORK-DRIVE DRUM turns once an hour and is also shifted endwise, so that spiraling pen lines trace the hours. A solenoid under the window lifts center pen once a minute to fix time within seconds. Robinson's records go to government and university stations.

tend to remain relatively at rest while the earth, floor and tower move.

Slender bars pivoted on a crosspiece of the tower are linked to bearing cups on the weighted cases. The longer ends of these bars carry the recording pens.

[Continued on page 246]



ELECTRIC PANEL BOARD controls clocks and time-recording equipment. Lamp panel and meter at the right signal even very slight movements of the earth's crust as you watch.

Phone Designed for Patient in Iron Lung

When three telephone men were asked to provide a man in an iron lung with a telephone, this is what they devised. The main problem was a switch that could be worked by a patient who could move only his head. The solution was a small box with a lever-type switch in it, attached to a long rod with a rubber tip. The patient opens and closes the circuit by biting on the tip and turning his head.

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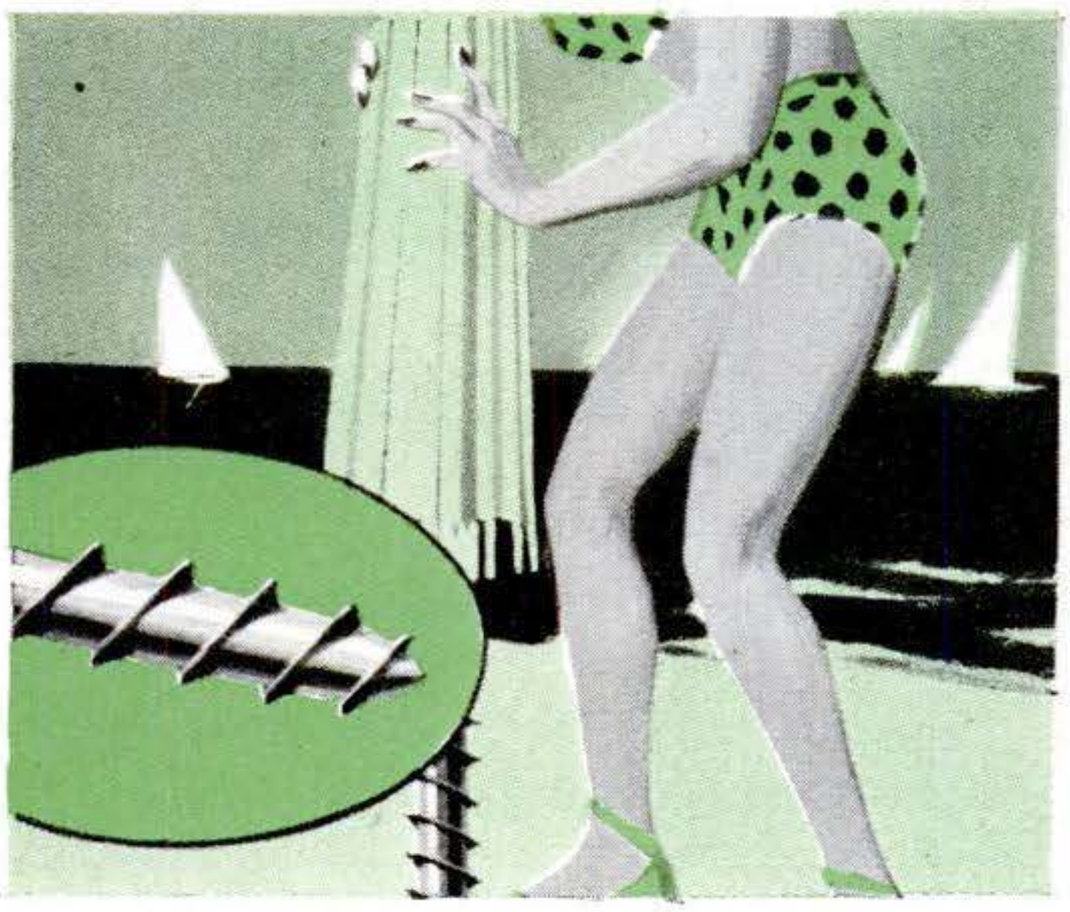
I'd Like to see them make...

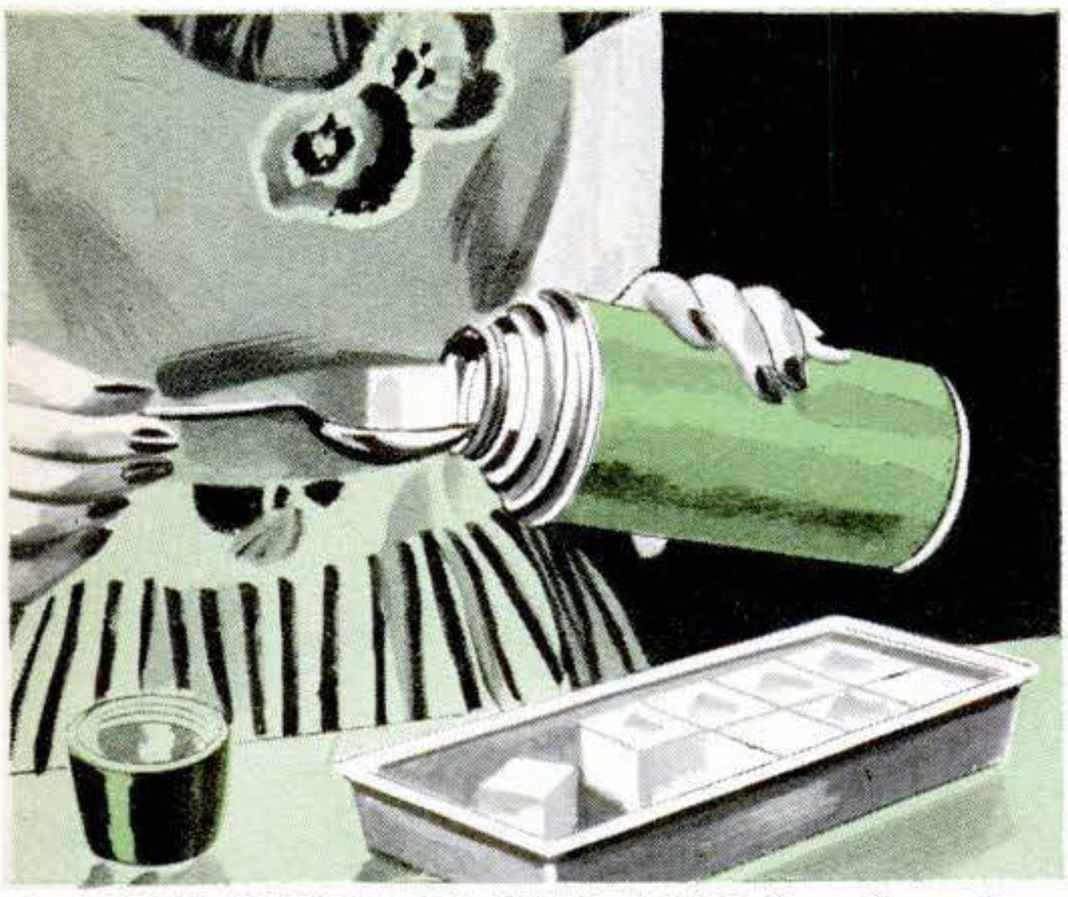
Everyone has his own pet idea of some gadget he would like to see in general use. What is YOURS? *Popular Science Monthly* will pay $5.00 for each one published. Use government postcards only. Contributions cannot be acknowledged or returned.

DISPOSABLE SUN LENSES for use over regular glasses. Paper-thin plastic, adhesive-backed to stick with pressure yet strip off easily, would do the job.—*H. Gage, S. Chatham, Mass.*

A GARDEN FENCE that could be raised up, riding on tracks in the supporting posts, to eliminate the tedious job of edge trimming.—*Lawrence Bridges, Kings Mountain, N. C.*



A BEACH UMBRELLA with a threaded, cone-shaped metal tip on the handle so that it could be inserted in the sand with less of a struggle. —*Alfred Manhan, NYC.*



A REFRIGERATOR ICE-CUBE TRAY for freezing ice in small enough pieces to fit into a small-necked vacuum bottle.—*Harold Charles, Indianapolis.*

A CLIP-ON BED FAN with a gooseneck so cool air could be directed to flow over length of the bed, yet not blow directly on head of the sleeper.—*R. Murdock, New Canaan, Conn.*

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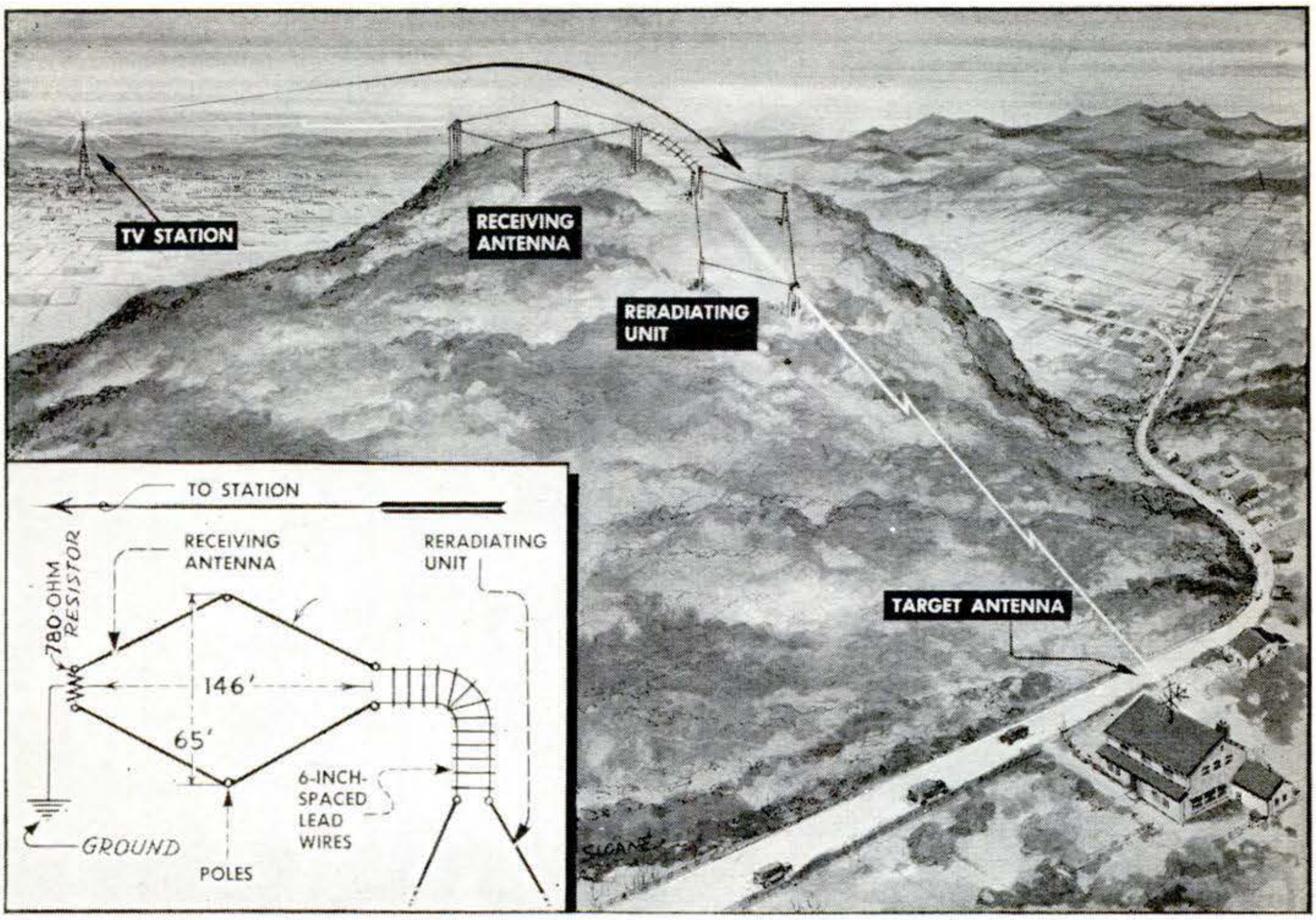
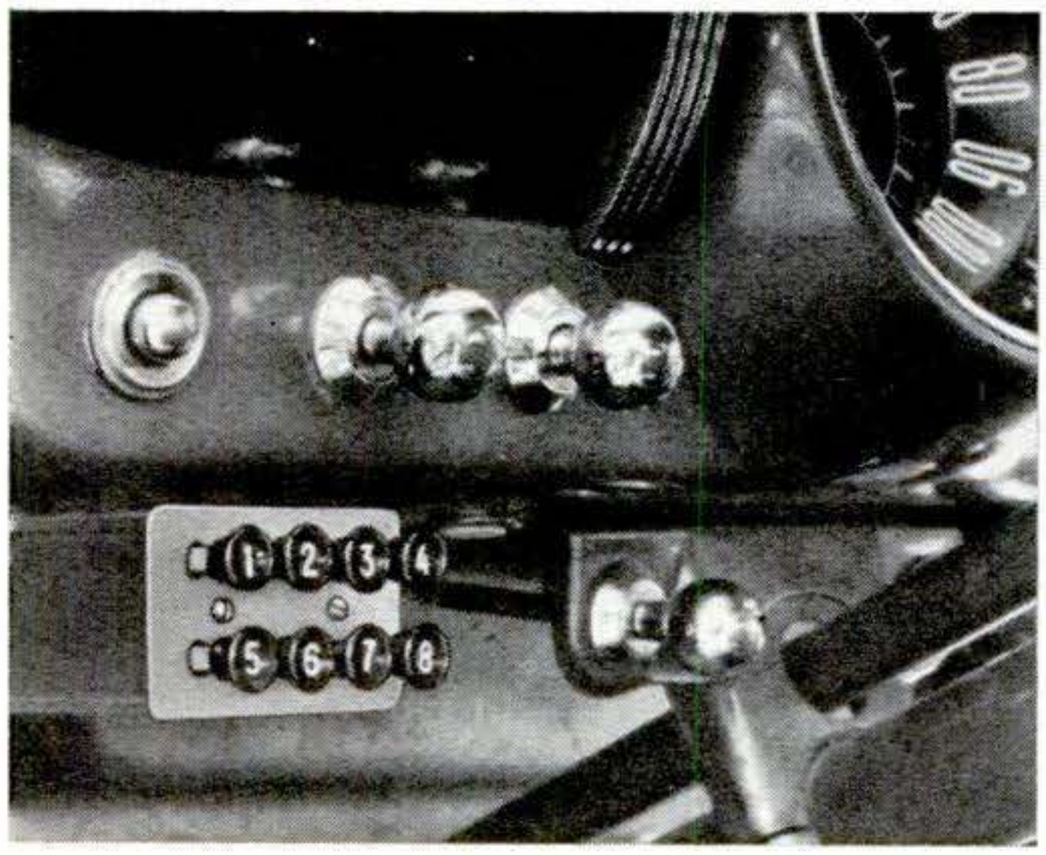


Homemade Relay Bends TV Over Mountain to Valley Home

A PRIVATE relay station that uses no electricity brings television shows over a mountain and down to the valley home of Col. Victor C. Huffsmith of the Denver Research Institute. The relay station is just two rhombic antennas—large, but inexpensive and easy to build—that could be copied by others who find TV reception similarly blocked.

The receiving antenna, aimed carefully at the transmitting station, picks up the signal and feeds it to the reradiating antenna, which rebroadcasts it through the air to the television-set antenna at the house.



Buttons Replace Car Key

You have to push the right buttons on this box under the dash to start the motor. Four buttons are used in a code known only to the owner. Victor Devices, Clifton, N. J., sells the Start-O-Code in kit form.

Plastic Tubs a One-Man Load

Now they're making bathtubs of glass and plastic, just like sports-car bodies. They weigh only 20 pounds, cost less than porcelain and won't chip. The Carl A. Strand Co., Birmingham, Mich., makes them.

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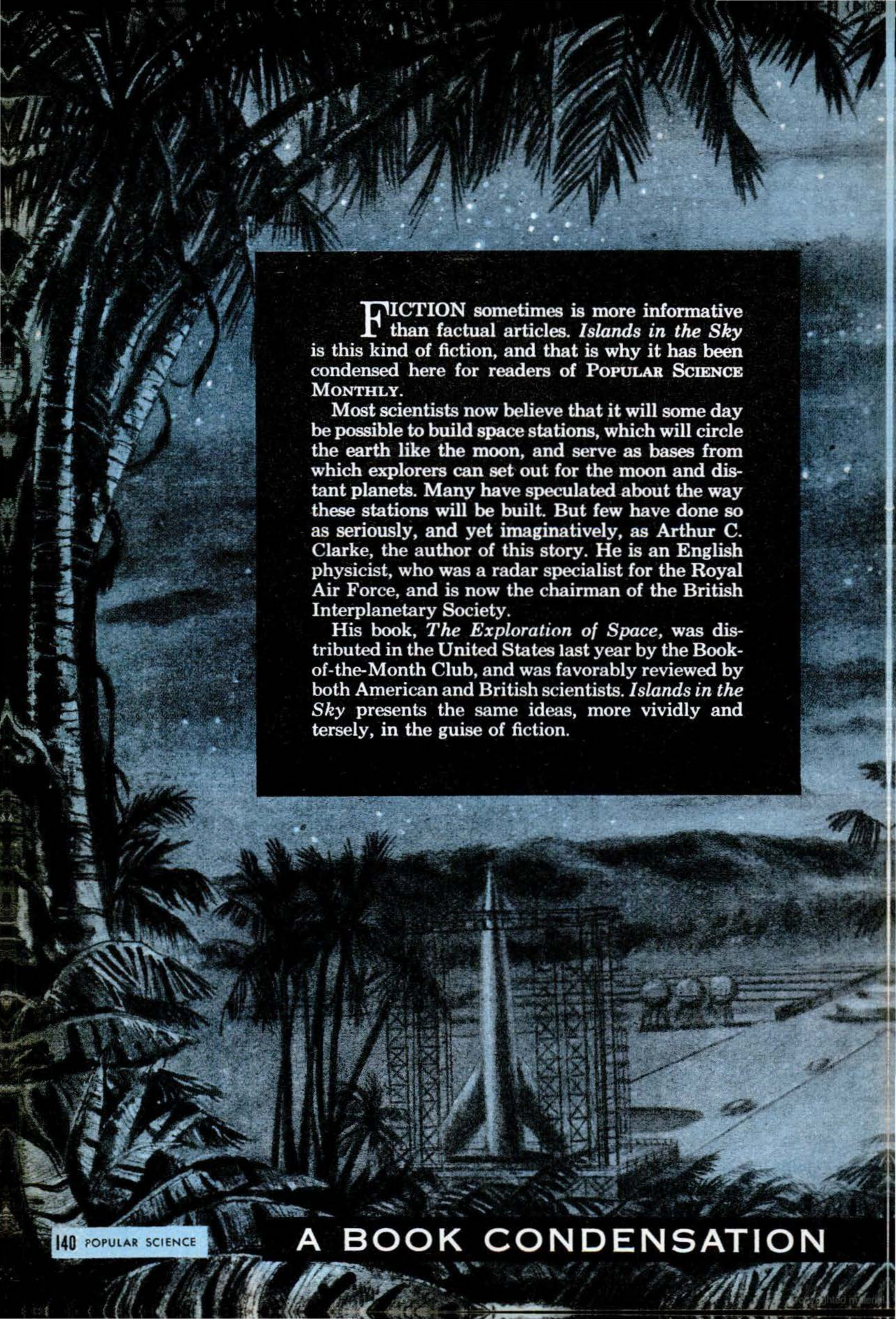
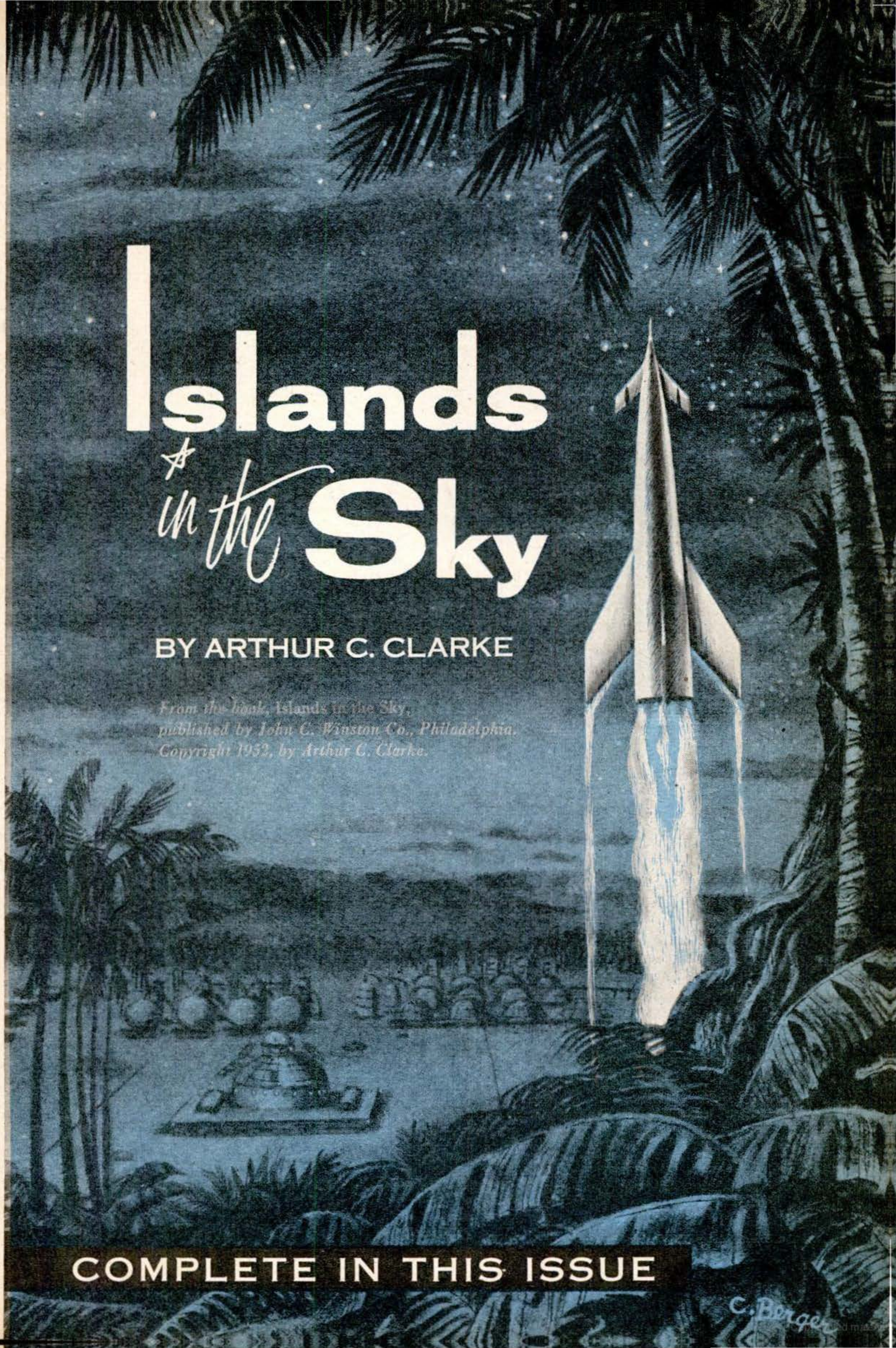


FICTION sometimes is more informative than factual articles. *Islands in the Sky* is this kind of fiction, and that is why it has been condensed here for readers of POPULAR SCIENCE MONTHLY.

Most scientists now believe that it will some day be possible to build space stations, which will circle the earth like the moon, and serve as bases from which explorers can set out for the moon and distant planets. Many have speculated about the way these stations will be built. But few have done so as seriously, and yet imaginatively, as Arthur C. Clarke, the author of this story. He is an English physicist, who was a radar specialist for the Royal Air Force, and is now the chairman of the British Interplanetary Society.

His book, *The Exploration of Space,* was distributed in the United States last year by the Book-of-the-Month Club, and was favorably reviewed by both American and British scientists. *Islands in the Sky* presents the same ideas, more vividly and tersely, in the guise of fiction.

A BOOK CONDENSATION



Islands in the Sky

BY ARTHUR C. CLARKE

From the book, Islands in the Sky, published by John C. Winston Co., Philadelphia. Copyright 1952, by Arthur C. Clarke.

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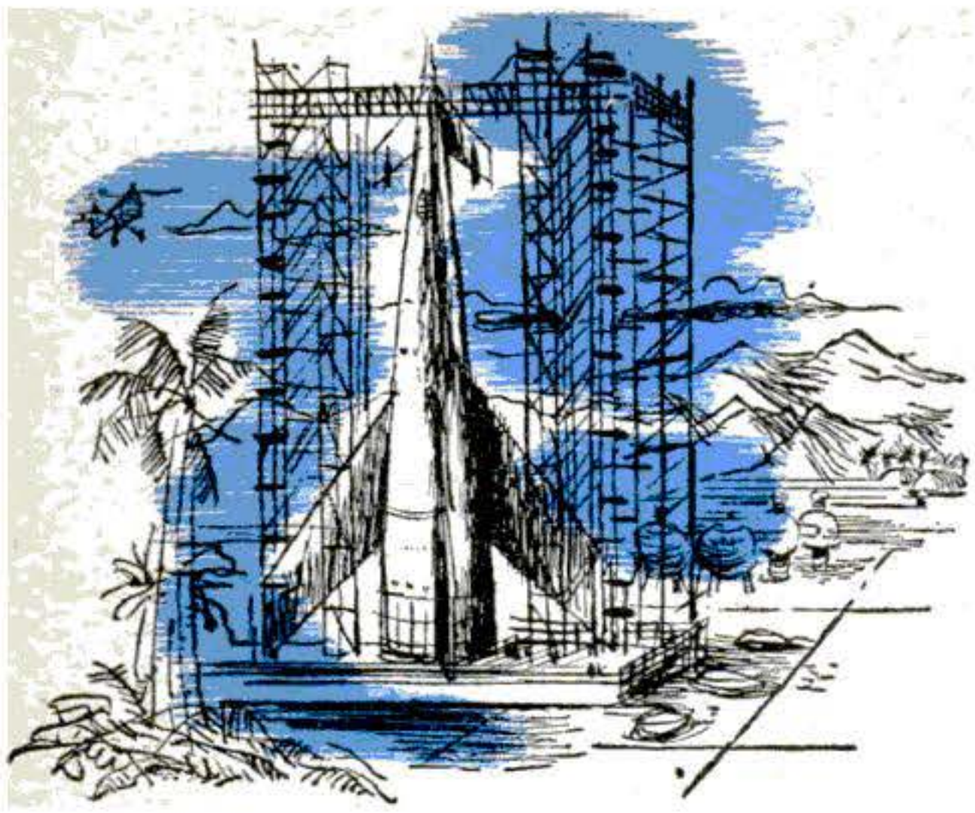

THE New Guinea mountains, just south of the Equator, must once have been among the wildest and most inaccessible spots on earth. Although the helicopter had made them as easy to reach as anywhere else, it was not until the twenty-first century that they became important as the main springboard into space.

They are so near the Equator that, because of the earth's spin, they're moving from west to east at a thousand miles an hour. That's a useful start for a ship on its way out to space. Their height puts the denser layers of the atmosphere below them. Thus air resistance is reduced and rockets can work more efficiently.

And, finally, ten thousand miles of open Pacific stretch away from them to the east. You can't launch spaceships from inhabited areas because, apart from the danger if anything goes wrong, the noise would deafen everyone for miles around.

Port Goddard is on a great plateau, leveled by atomic blasting, almost two and a half miles up. There is no way to reach it by land—everything comes by air. It is the meeting place for ships of the atmosphere and ships of space.

When I first saw it from our approaching jet, it looked like a tiny white rectangle among the mountains. Great valleys packed with tropical forests stretched as far as one could see. When I stepped out into the cold, clear air, I already felt so far above sea level that I looked up into the sky to see if I could find my destination, Space Station One.

But I wasn't allowed time for the search. There were forms to be filled. I was weighed carefully and given pills to swallow (they made sure that I did too), and we climbed aboard a little truck that would take us out to the launching site. I was to be the only passenger, as the rocket on which I was traveling was a freighter.

Most spaceships, naturally enough, have astronomical names. I was flying on the *Sirius,* one of the smaller ships. She had already been raised in her cradle so that her prow pointed at the sky, and she seemed balanced on the great triangles of her wings. These would come into action only when she glided back into the atmosphere on her return to earth; at the moment they served merely as supports for four huge fuel tanks, which would be jettisoned as soon as dry.

The servicing gantry was still in position, and when I stepped into the elevator a motor began to whine. The metal walls of the *Sirius* slid swiftly past, the elevator came gently to a halt, and the gates opened onto a short gangway. I walked across it, through the open seals of the air lock, and brilliant tropical sunlight gave way to the cold electric glare of the ship's control room.

The pilot was already in his seat, going through the routine checks. He swiveled round and gave me a cheerful grin.

"So you're Roy Malcolm? Have you flown in a rocket before?"

"No," I replied.

"Then don't worry. Make yourself comfortable in that seat, fasten the straps, and relax. We've got twenty minutes."

I climbed into the pneumatic couch, but it wasn't easy to relax. After years of dreaming, I was aboard a spaceship at last! In a few minutes, a hundred million horsepower would be hurling me up into the sky.

THE pilot was talking to the Port Control Tower over the radio. Every so often a time-check broke through: "Minus fifteen minutes . . . Minus ten minutes . . . Minus five minutes."

At last the pilot said "Over to Automatic" and threw a large red switch. He gave a sigh of relief and leaned back.

"That's always a nice feeling," he said. "No more work for the next hour!"

He didn't really mean that, of course. Although the robot controls would handle the ship, he still had to see that everything was going according to plan. In an emergency, he would have to take over.

The ship began to vibrate as the fuel pumps started to spin. A complicated pattern of intersecting lines appeared on a TV screen. Tiny lights changed, one after another, from red to green.

I snuggled down into the couch and then,

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without warning, felt as if someone had jumped on me. There was a tremendous roaring in my ears. I seemed to weigh a ton. It required a definite effort to breathe.

The discomfort lasted only seconds, then I grew accustomed to it. The ship's own motors had not yet started, and we were climbing under the thrust of the booster rockets, which would burn out and drop away after thirty seconds.

I could tell when they did by the sudden slackening of weight. It lasted only a moment, then there was a subtly changed roaring as our own rockets started to fire. They would keep up their thunder for another five minutes. At the end of that time, we would be moving so swiftly that the earth could never drag us back.

The thrust of the rockets was now giving me more than three times my normal weight. I tried to see if I could raise my arm. It was very tiring. I think I could have sat upright if necessary, but standing would have been impossible.

On the TV screen, the pattern seemed unaltered. Now, however, a tiny spot crept slowly upward—representing, I supposed, the ascending ship. I watched it, wondering if the motors would cut out when the spot reached the top of the screen.

Long before that happened, there came a series of short explosions, and the ship shuddered slightly. I thought that something had gone wrong. Then I realized our drop tanks had been emptied, and the bolts holding them had let go. They were falling back and would plunge into the Pacific.

At last the thunder of the rockets began to lose its power, and the feeling of enormous weight ebbed away. The ship was easing into its final orbit, five hundred miles above the Equator. The motors had done their work and were now merely making adjustments to our course. Silence returned as the rockets cut out completely.

The pilot finished checking his instruments and then released himself from his seat. I watched him, fascinated, as he floated across to me.

"It will take you some time to get used to this," he said, as he unbuckled my strap. "The thing to remember is—always move gently. And never let go of one handhold until you've decided on where you're going next."

Gingerly, I stood up. I grabbed the couch just in time to stop myself from zooming to the ceiling. "Up" and "down" had vanished completely. Weight had ceased to exist, and I had only to give myself a gentle push and move rapidly in any direction I wished.

It's strange, but even now there are people who don't understand "weightlessness." They seem to think it has something to do with being "outside the pull of gravity." That's nonsense, of course. In a space station or a coasting rocket five hundred miles up, you feel weightless not because you're outside gravity, but because you're no longer resisting its pull. You could feel weightless, even on earth, inside a freely falling elevator—as long as the fall lasted. An orbiting space station or rocket is in a permanent fall—a "fall" that can last forever because it isn't toward the earth but around it.

I grabbed the couch just in time to stop myself from zooming to the ceiling. "Up" and "down" had vanished completely.

"Careful, now!" warned the pilot. "I don't want you cracking your head against my instruments! If you want to look out the window, hang on to this strap." I obeyed him and peered through the thick plastic—all that lay between me and nothingness.

My field of view was almost entirely filled by the Pacific Ocean. It was a surprisingly deep azure, which softened into a misty blue at the horizon. I asked the pilot how far away this was.

"About two thousand miles," he replied. "You can see most of the way down to New Zealand and up to Hawaii."

The coast of South America was coming into sight when the pilot began to prepare for landing on the Inner Station. (I know

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"landing" sounds peculiar, but it's the expression used.) I was still staring out of the little porthole when I was told to go back to my seat, for the final maneuvers.

The TV screen was now a black rectangle, with a tiny double star shining near its center. We were about a hundred miles from the station, slowly overhauling it. When only a few miles away, we started to put on the brakes. There was a high-pitched whistling from the steering jets, and for a moment a feeble sensation of weight returned. It lasted only a few seconds; then we had matched speeds and joined the station's satellites.

My first impression of the Inner Station was one of complete chaos. Floating there in space was a great open latticework of spidery girders, in the shape of a flat disk. Here and there on its surface were spherical buildings, connected by tubes wide enough for men to travel through. In the center of the disk was the largest sphere of all, dotted with portholes and with antennae jutting in all directions.

Several spaceships, some almost completely dismantled, were attached to the great disk at various points. They looked, I thought, much like flies caught in a spiderweb. Men in space suits were working on them, and sometimes the glare of a welding torch would dazzle my eyes.

Other ships were floating freely, in no particular system, around the station. Some were streamlined, winged vessels like the one that had brought me from earth. Others were true ships of space—assembled here outside the atmosphere and designed to ferry loads from world to world without ever landing on any. They were weird, flimsy structures, usually with a pressurized spherical chamber for the crew and passengers, and larger tanks for the fuel, linked together by thin struts.

I was wondering how we were going to get aboard the station when something came sweeping into my field of vision. It was a cylinder just big enough to hold a man—and it did hold a man, for I could see his head through the plastic panels at one end. Long, jointed arms projected from the machine's body, and it trailed a thin cable behind it. I could just make out the faint jet of the tiny rocket motor which propelled this miniature spaceship.

The operator must have seen me staring at him, for he grinned back as he flashed by. A minute later there came an alarming "clang" from the hull of our ship. The pilot laughed at my fright.

"That's only the towing cable being coupled. It's magnetic, you know. We'll start to move in a minute."

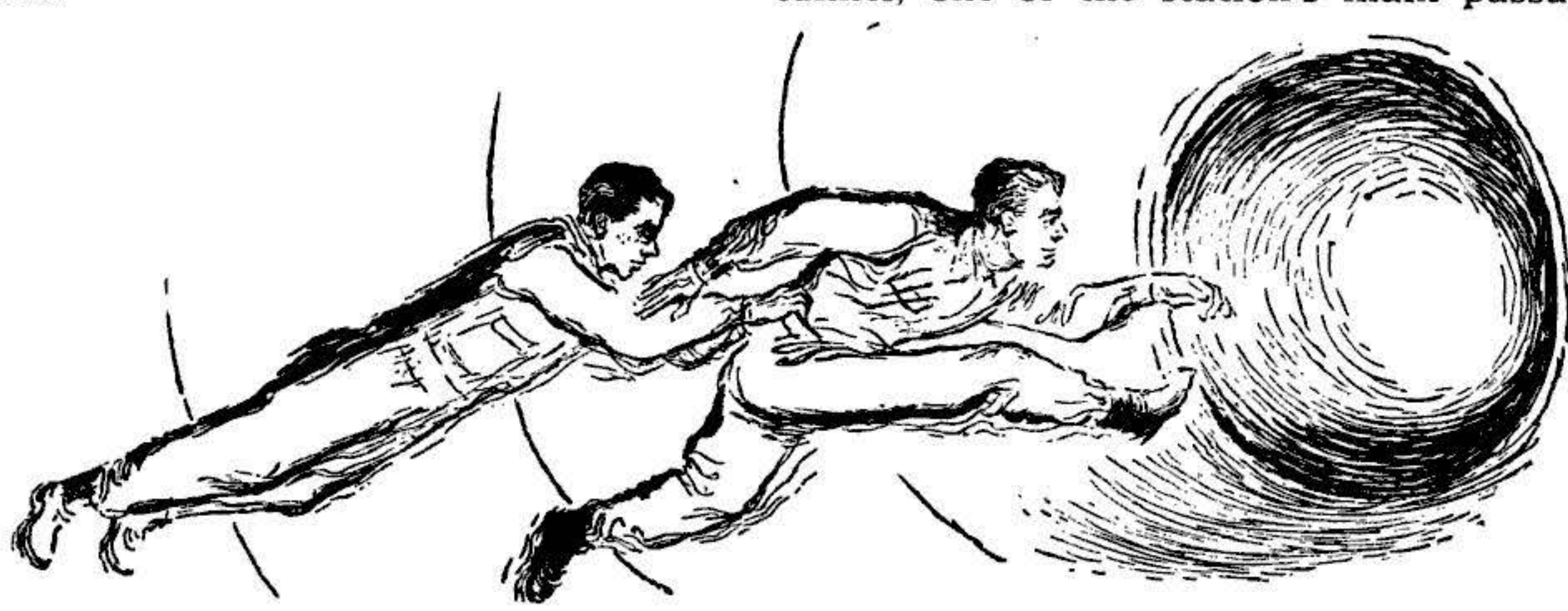
There was the feeblest of tugs, and our ship slowly rotated until it was parallel to the great disk of the station. The cable had been attached amidships, and we were being hauled in like a fish on a line.

Soon there was a series of bangings and scrapings from the air lock, followed by an alarming hiss of air. It slowly died away, and presently, with a soft sucking noise, the inner door of the pressure chamber swung open.

"Remember about moving slowly," said the pilot, gathering up his log book. "The best thing is to hitch on to my belt and I'll tow you. Ready?"

It wasn't very dignified. But it was safest to take no risks, so that was the way I traveled through the flexible, pressurized coupling clamped on to the side of our ship. The pilot launched himself with a powerful kick and I trailed along behind him, with a firm grip on his belt.

Presently we emerged into a wide metal tunnel, one of the station's main passage-



The pilot launched himself with a powerful kick, and I trailed along behind him through the flexible, pressurized coupling clamped to our ship.

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ways, I guessed. Cables and pipes ran along the walls, and at intervals we passed through great double doors with red EMERGENCY notices on them.

"I'm taking you to Commander Doyle," the pilot explained. "He's in charge of training and will be keeping an eye on you."

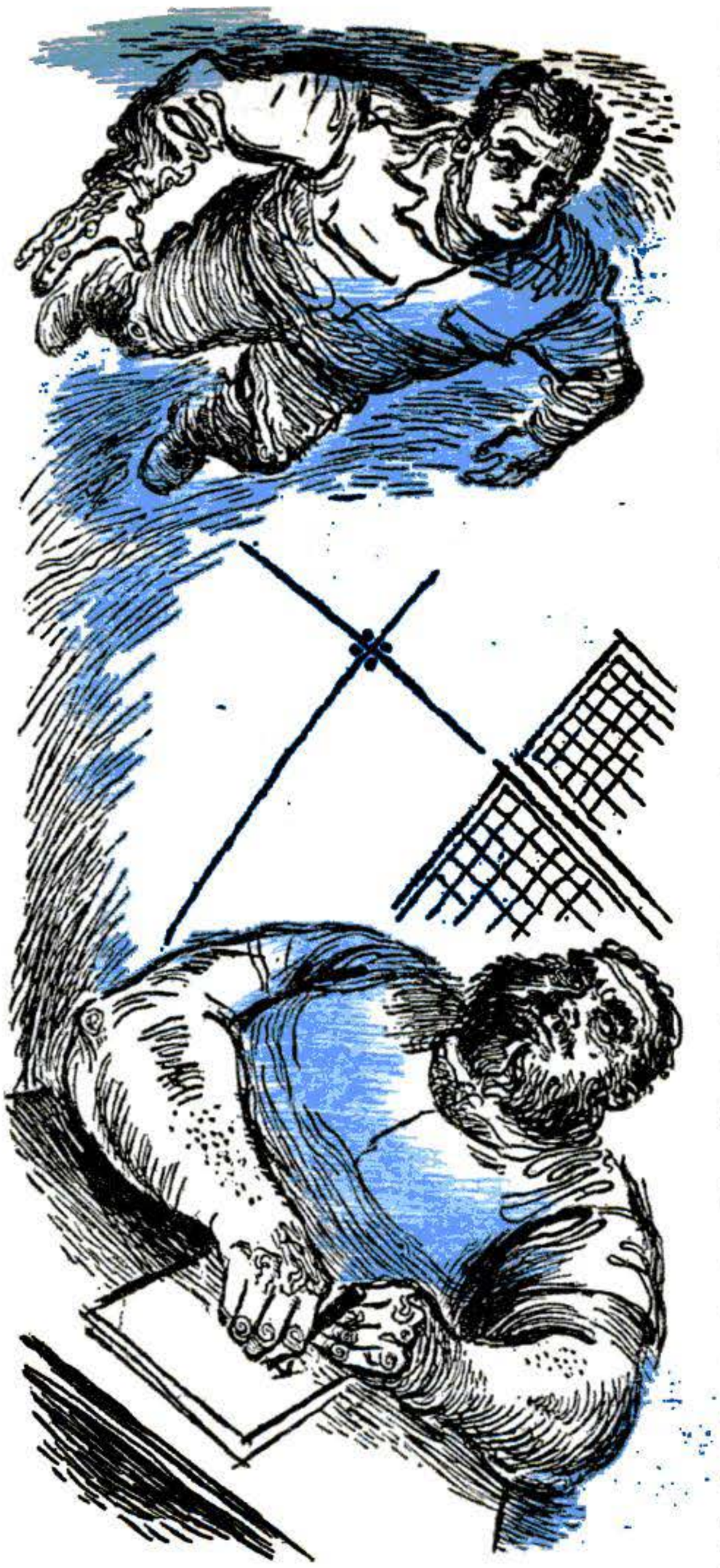
"What sort of man is he?" I asked.

"You'll find out soon. Here we are."

We drifted to a halt in front of a circular door carrying the notice: "Cdr. R. Doyle, i/c Training. Knock and Enter." The pilot did both, still towing me.

I heard him say: "Captain Jones reporting, Mr. Doyle—with passenger." Then he shoved me in front and I saw the man addressed.

He was sitting at an ordinary office desk, which was rather surprising in this place where nothing else seemed normal. And he looked like a prize fighter. Two huge arms covered most of the desk before him.



By the time Commander Doyle had finished, I'd drifted away from the floor and was floating helplessly in mid-air again.

When he looked up, I found myself staring at a huge red beard and two enormous eyebrows. Commander Doyle wasn't a handsome man. But he was certainly a striking one, and my big surprise was still to come.

"So you're Roy Malcolm, eh?" he said, in a pleasant voice. "O.K., Captain Jones—I'll take charge of him now."

The pilot saluted and glided away. For the next ten minutes Commander Doyle questioned me closely, building up a picture of my life and interests. When he had finished writing this down, he drummed thoughtfully on the desk with his huge fingers. I was feeling a bit scared, and to make matters worse I'd drifted away from the floor and was floating helplessly in mid-air again. The commander gave a chuckle.

"Afternoon classes have just stopped," he said. "I'll take you to meet the boys." Then he grabbed a long metal tube that must have been slung underneath the desk, and launched himself out of his chair with a single jerk of his huge left arm.

He moved so quickly that it took me completely by surprise. A moment later I just managed to stifle a gasp of amazement. For as he moved clear of the desk, I saw that Commander Doyle had no legs.

It was a long time before I discovered what had happened to him. The accident occurred when he was on the first expedition to Mercury. It was obvious why he had come to the station; it was the only place he wouldn't be a cripple. Indeed, thanks to his powerfully developed arms, he was probably the most agile man in the station. He had lived here for ten years and would never return to earth, where he would be helpless again.

MY FIRST day on the Space Station, I had to learn how to live all over again. I couldn't judge the effort needed to make any movement. Although weight had vanished, momentum remained. It required force to start something moving, and more force to stop it again. That was where the broomsticks came in.

They consisted of one hollow tube sliding inside another. The two were connected by a powerful spring, one tube ending in a hook, the other in a wide rubber pad. If you wanted

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to move, you put the pad against the nearest wall and shoved. The recoil launched you into space, and when you arrived at your destination you let the spring absorb your velocity and so bring you to rest. Trying to stop yourself with your bare hands was liable to result in sprained wrists.

There were about a hundred people on board the Inner Station, ten of them apprentices. The senior apprentice was a tall, quiet Canadian named Tim Benton. It was Tim who taught me my way around the Inner Station.

"I suppose you know what we do up here?" he said when the commander had left us.

"You refuel spaceships out from earth, and carry out repairs and overhauls."

"Yes, that's our main job. The stations farther out have many other duties, but we needn't bother about that now. There's one important point I'd better make clear right away. This Inner Station is really in two parts, with a couple of miles between them. Come look."

He pulled me over to a port and I stared out. Hanging there, so close that it seemed I could touch it, was what looked like a giant flywheel. It was slowly turning on its axis, and as it revolved I could see the glitter of sunlight on its observation ports. I could not help comparing its smooth compactness with the flimsy, open girder work of the station in which I was. The great wheel had an axle, for jutting from its center was a long, narrow cylinder which ended in a curious structure I couldn't understand.

"That's the Residential Station," said Benton disapprovingly. "It's nothing but a hotel. Because it's spinning, it's got normal earth gravity at the rim. It wouldn't be safe for passengers from Mars and the moon to go straight to earth after living in a much lower gravity field. They're transshipped to the Residential Station to get acclimatized. They go in at the center, where there's no gravity, and work slowly out to the rim, where it's earth normal."

"How do they get aboard if it's spinning?"

"See that ship moving into position? If you look carefully, you'll see that the axle of the station isn't spinning; it's driven by a motor against the station's spin so that it actually stands still. The ship can couple to it and transfer passengers. The coupling's free to rotate, and once the axle revs up with the station, the passengers can go aboard."

"Will I have a chance to go there?"

"I expect it could be arranged—though I don't see much point in it. You might just as well be down on earth."

It must have been quite a bother showing me around, because I had to be pushed or pulled most of the way until I'd found my "space legs." Once or twice Tim just managed to rescue me when I'd launched myself too vigorously and was about to plunge headlong into an obstacle.

It was several days before I really knew my way around the maze of corridors and pressure chambers that was the Inner Station. In that first trip I merely had a quick survey of its workshops, radio equipment, power plant, air-conditioning gear, storage

Tim showed me how to get into the suit. The lower part of it was simply a rigid cylinder. When I climbed inside, I found my feet could work the pedals.

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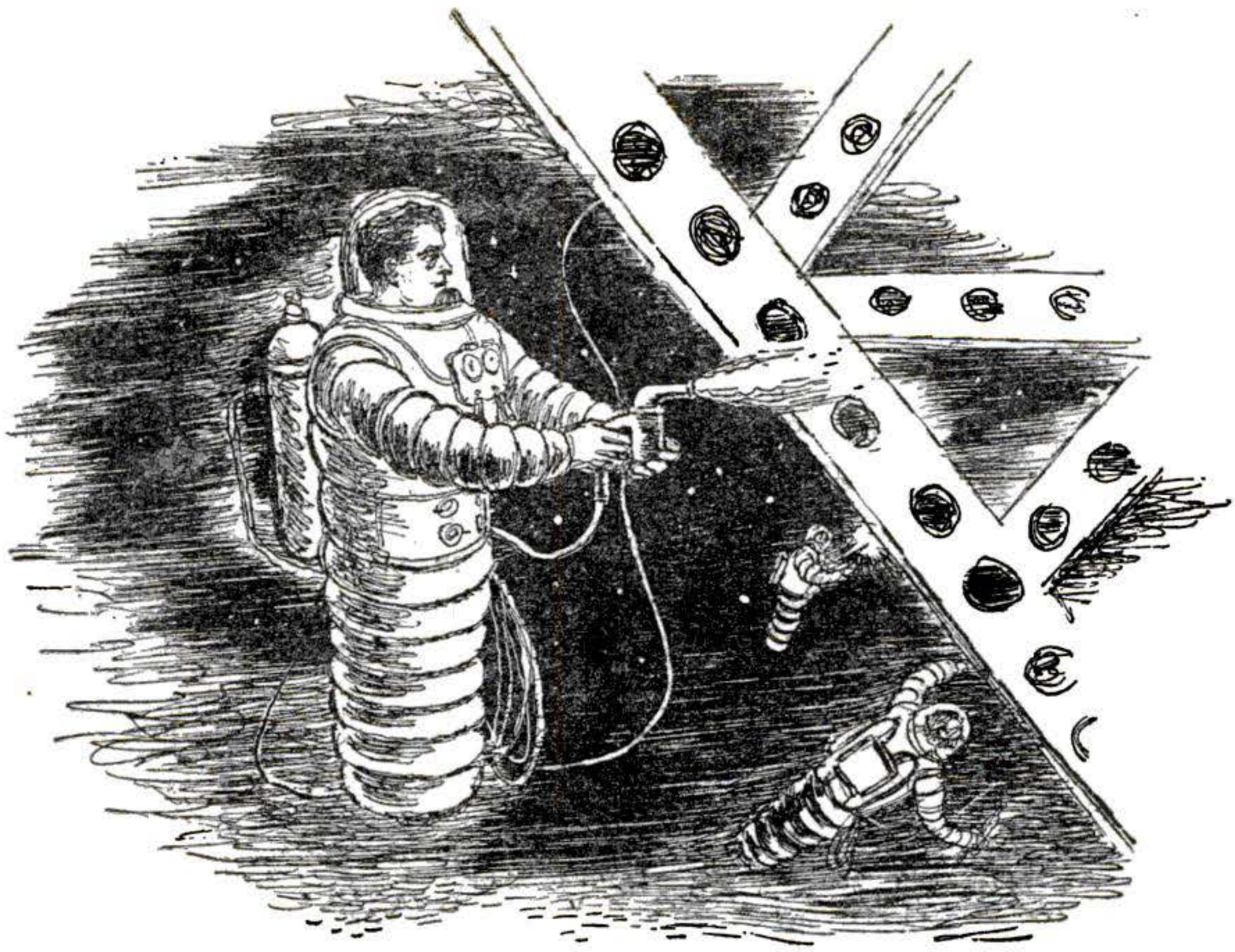

A spaceship with plating stripped off was secured by cords that wouldn't support a man on earth. Several mechanics wearing suits like our own were working on the hull.

tanks and observatory. Sometimes it was hard to believe that all this had been carried into space and assembled here five hundred miles above the earth. I didn't know, until Tim mentioned it, that most of the material had actually come from the moon. Its low gravity made it more economical to ship equipment from there instead of from earth, even though earth was closer.

My first tour ended inside one of the air locks. We stood in front of a great circular door, resting snugly on rubber gaskets, which led into outer emptiness. Clamped to the walls were space suits.

"Do you think I'll have a chance of trying one while I'm here?" I asked.

Tim looked thoughtful; then he glanced at his watch.

"I'm not on duty for half an hour, and I want to get something I left out at the rim. We'll go outside."

"But . . ." I gulped. "Doesn't it take a lot of training to use one of these?"

Tim answered my question while he was showing me how to get into the suit.

"Of course it takes a lot of training before you can operate one. I'm not going to let you try. You sit tight inside and tag along with me."

To most people, the word "space suit" conjures up something like a diving dress, in which a man can walk and use his arms. Such suits are used on places like the moon. But on a space station legs aren't much use anyway, because outside you have to blow yourself around with tiny rocket units.

For this reason, the lower part of the suit was simply a rigid cylinder. When I climbed inside it, I found that my feet could work control pedals. A transparent dome gave me good visibility. Just below my chin there was a tiny keyboard and a few meters. To handle anything outside, there were flexible sleeves through which I could push my arms. They ended in gloves which enabled one to carry out quite delicate operations.

Tim threw some switches on my suit and clamped the dome over my head. I felt like being inside a coffin with a view. Then he chose his suit and attached it to mine by a thin nylon cord.

The inner door of the air lock thudded shut behind us. I could hear the vibration of pumps as the air was sucked back into the station. My sleeves began to stiffen slightly. Tim called to me, his voice distorted by our helmets.

"I won't switch on the radio yet. You

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should still hear me. Listen to this." Then he went into the familiar routine: "Testing, One, Two, Three, Four, Five . . ."

Around "Five" his voice began to fade. When he'd reached "Nine" I couldn't hear a thing. There was no longer enough air around us to carry sound. The silence was uncanny. I was relieved when talk came through my suit speaker.

"I'm opening the outer door now. Don't move—I'll do all that's necessary."

In eerie silence, the great door slowly opened inward. I was floating freely now, and felt a faint tug as the last traces of air puffed out into space. A circle of stars was ahead of me. I could just glimpse the misty rim of earth.

"Ready?" asked Tim.

"O.K.," I said, hoping that the microphone wouldn't betray my nervousness.

The tow line gave a tug as Tim switched on his jets, and we drifted out of the air lock. It was a terrifying sensation. Reason told me I was perfectly safe, but all instinct shouted, "You've a five-hundred-mile fall straight down beneath you!"

We were in sunlight at the moment, passing across Africa, and I could see Lake Victoria and the great forests of the Congo. Though it was fascinating to look at earth, it made me dizzy, so I swiveled round in my suit to concentrate on the station. Tim had now towed us well clear of it, almost into the halo of floating ships.

A spaceship with most of its plating stripped off was secured from drifting away by a couple of cords that would hardly have supported a man on earth. Several mechanics wearing suits like our own were working on the hull.

"I'll leave you here a minute," said Tim, clipping my tow line to the nearest girder. "Don't do anything until I get back."

I felt rather foolish, floating like a captive balloon, and was glad no one took any notice of me. Suddenly it began to grow dark. Until this moment, the station and the ships beside it had been bathed in brilliant light from a sun so fierce that I had not dared to look anywhere near it. But now the sun was passing behind the earth as we hurtled across the night side of the planet. I turned to a sight so splendid that it took my breath away.

Earth was a huge, black disk eclipsing the stars, but all along one edge was a glorious crescent of golden light, shrinking even as I watched. The men around me took not the slightest notice of it. The station circled the earth so swiftly that sunset occurred every hundred minutes.

It was not completely dark, for the moon was half full, looking no brighter or closer than from earth. The sky was so crowded with stars, all shining without twinkling, that I wondered how anyone could ever have spoken of the "blackness" of space.

I was so busy looking for the other planets (and failing to find them) that I never noticed Tim's return until my towrope began to tug.

THE apprentices didn't spend all their time aboard Space Station One. Not far from it was a floating graveyard of ships that had been withdrawn from service. Most of them had been stripped of their instruments and were no more than skeletons. Among these derelicts were some great pioneers—the first ship to land on Venus, the first to reach the satellites of Jupiter, the first to circle Saturn. At the end of their long voyages home, they had entered the five-hundred-mile orbit round earth and ferry rockets had taken off their crews. Then they had been retired here, never to be used again.

All, that is, except the *Morning Star*. She had made the first circumnavigation of Venus, in 1985. But very few people knew that she was still in excellent repair, for the apprentices had adopted her and got her into working condition again.

Commander Doyle knew all about this and approved of it. After all, it was good training. Sometimes he came over to the *Morning Star,* but it was generally understood that the ship was private property. You had to have an invitation to get aboard. Not until I'd been around for some days, did I get to the ship.

It was the longest journey I had made outside the station, for the graveyard was five miles away, in the same orbit as the station but a little ahead of it. The curious vehicle in which we made the trip had been constructed of junk and was really nothing but a pressurized cylinder, large enough to hold a dozen people. A low-powered rocket unit had been bolted to one end, there were auxiliary steering jets, a simple air lock, a radio—and that was all. This peculiar vessel could hop across to the *Morning Star* in ten minutes, being capable of a top speed of about thirty miles an hour.

Christened *The Skylark of Space,* she was

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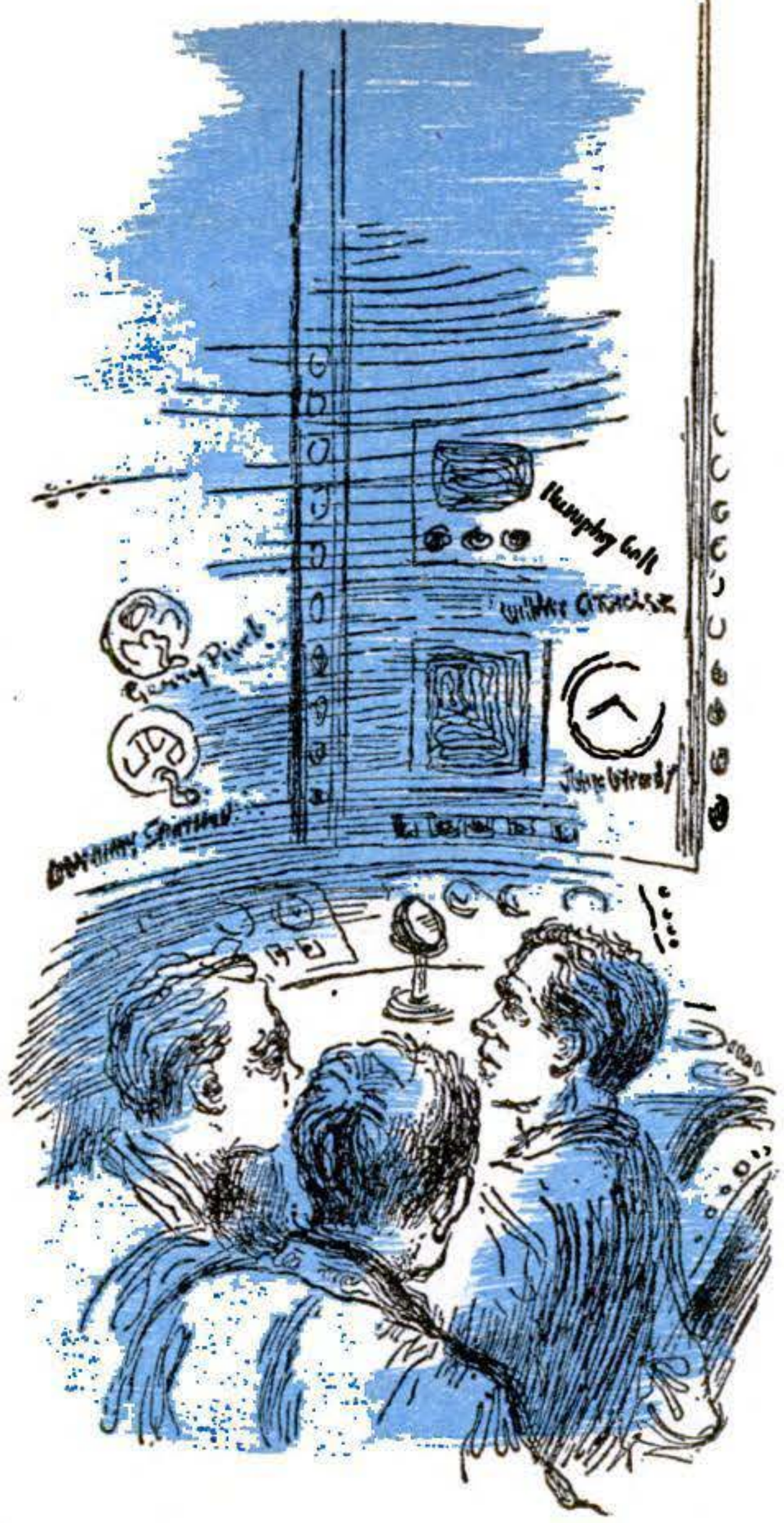
usually kept at the outer rim of the station, out of the way. When she was needed, a couple of apprentices would go out in space suits, loosen her mooring lines, and tow her to the nearest air lock. Then you could go aboard through a coupling tube, just as if you were entering a real space liner.

The *Skylark* looked so ramshackle that I expected her to fall to pieces any moment, though in fact she had an adequate margin of safety. With ten aboard, her little cabin was crowded, and when the rocket motor started up, the gentle acceleration made us all drift slowly toward the rear. The thrust was so feeble that it made me weigh only about a pound, quite a contrast to the take-off from earth. After a minute or so we shut off the drive and drifted another ten minutes, by which time a brief burst brought us to our destination.



The names of those five men who had circumnavigated Venus in 1985 were scratched on the control panel. They took me back to the early days of space flight.

There was plenty of room inside the *Morning Star;* after all, she had been the home of five men for almost two years. Their names were still there, scratched on the paint in the control cabin, and those signatures took my imagination back almost a hundred years, to the pioneering days of space flight.

DESPITE the ship's age, everything in the control room seemed almost new. The instrument board might have belonged to a craft of my own time. Tim Benton stroked the panel gently. "As good as new!" he said, with obvious pride. "I'd guarantee to take you to Venus any day!" But nobody dreamed the ship would soon have to prove itself.

In my prowling around the station, I had soon visited just about every part that wasn't out of bounds. The forbidden territory included the radioactive power plant, the Stores Section and the main control room. This was one place I badly wanted to go; it was the "brain" of the station, from which radio contact was maintained with all ships in this section of space, and with earth itself.

One of the tasks of junior apprentices was to take coffee and refreshments to the duty officer in the middle of his watch. This always occurred when the station was crossing the Greenwich Meridian. Since it took exactly a hundred minutes to make one trip around earth, everything was based on this interval and our clocks timed a local "hour" of this length. After a while one judged the time by glancing at the earth and seeing what continent was beneath.

The coffee, like all drinks, was carried in closed containers and had to be drunk by sucking through a tube, since it wouldn't pour in the absence of gravity. The refreshments were taken up to the control room in a light frame with holes for the containers, and their arrival was always much appreciated by the staff on duty.

It took a lot of persuading before I got this job. I pointed out that it relieved the others for more important work; to which Tim retorted that it was one of the few jobs they liked. But at last he gave in.

I'd been carefully briefed, and just as the station was passing over the Gulf of Guinea I stood outside the control room and tinkled my little bell. (There were a lot of quaint customs like this.) The duty officer shouted, "Come in!" I steered my tray through the door and handed out the food and drinks.

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Besides the duty officer and his assistant, there were several radio operators, and other men working on equipment I couldn't recognize. Dials and TV screens were everywhere, lights were flashing, yet the whole place was silent. The men sitting at their little desks were wearing headphones and throat microphones, so that any two people could talk without disturbing others.

The duty officer sat at a huge glass-topped desk on which glowed a complicated pattern of colored lights. It showed the earth, the orbits of the other stations and the courses of all ships in our part of space. From time to time he would say something and I knew that some order was winging its way to an approaching ship.

One of the assistants was kind enough to show me around. He let me listen to some of the radio conversations, and explained the workings of the great display panel. The thing that impressed me most of all, however, was a shining cylinder, covered with controls and winking lights, in the center of the room.

"This," said my guide proudly, is HAVOC."

"What?" I asked.

"Short for Automatic Voyage Orbit Computer."

"What does the *H* stand for?"

"Everyone asks that. It doesn't stand for anything." He turned to the operator. "What's she set up for now?"

The answer was mostly in mathematics, but I did catch the word "Venus."

"Right. Suppose we wanted to leave for Venus in four hours . . ."

His hands flicked a keyboard like that of an overgrown typewriter. A few lights changed color. Then after about ten seconds, a buzzer sounded and a tape slid out of a slot. It was covered with closely printed figures.

"There you are," said my guide. "Direction of firing, elements of orbit, time of flight, when to start braking. All you need is a spaceship!"

OUR space station, only five hundred miles up, was the nearest to the earth; there were others at much greater distances. The purpose of the Inner Station was to act as a refueling, repair and transfer point for spaceships. For this it was necessary to be as close to the earth as possible.

The Meteorological Stations, on the other hand, had to be a fair distance out to "see" as much of the earth as possible. There were two of them, six thousand miles up, circling the world every six and a half hours over the Equator. Though they could see much farther north and south than we could, the polar regions were still out of sight or badly distorted. Hence the Polar Met Station which, unlike all others, had an orbit passing over the poles.

Beyond the Met Stations, fifteen thousand miles up, circled the biology labs and the famous Space Hospital. There research into zero-gravity conditions was carried out, and many diseases incurable on earth could be treated. For example, the heart no longer had to work so hard and could be rested in a manner impossible on earth.

Finally, twenty-two thousand miles out, were the three great Relay Stations. They took exactly a day to make one revolution; therefore they appeared to be fixed forever over the same spots on the earth. Linked by tight beams, they provided TV, long-distance radio and 'phone coverage over the whole planet.

One station, serving the Americas, was in Latitude 90° West. A second, in 30° East, covered Europe and Africa. The third, in 150° East, served the entire Pacific area. There was no spot on earth where you could not pick up one of the stations.

The different orbits were connected by a shuttle service of small rockets which made trips at infrequent intervals. On the whole, however, there was little traffic between the stations. Most of their business was done directly with earth.

I WAS in the *Morning Star* watching Ronnie Jordan work on a model spaceship when the radio called. It was Tim Benton, on duty at the station. He sounded very excited.

"Is that Ron? Anyone else there—only Roy? Well, listen to this, it's very important. We want to use the *Morning Star*. I've promised the commander that she'll be ready in three hours."

"What!" gasped Ronnie. "I don't believe it!"

"There's no time to argue—I'll explain later. The others are coming over right away. Make a list of these points and start checking."

For the next twenty minutes we were busy testing the controls. Presently there was a bumping and banging from the air lock and three of our colleagues came aboard, towing

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batteries and tools. From them we discovered what all the fuss was about.

One passenger from a Mars-Earth liner, which had just docked at the Residential Station, was seriously ill and had to have an operation within ten hours. The only chance of saving his life was to get him to the Space Hospital, but all the ships at the Inner Station were being serviced and it would take a day to get one spaceworthy.

It was Tim who'd talked the commander into giving us this chance. The *Morning Star*, he had pointed out, was fully up to a trip to the Space Hospital. It wouldn't even be necessary to use the main motors. The journey could be made on auxiliary rockets.

Since he could think of no alternative, Commander Doyle had reluctantly agreed, on certain conditions. We had to get the ship over to the station under her own power to be fueled up—and *he* would do all the piloting.

And so the *Morning Star* began her first voyage in almost a hundred years. It was not much of a journey, compared with her great trip to Venus. Yet to us it was a real adventure.

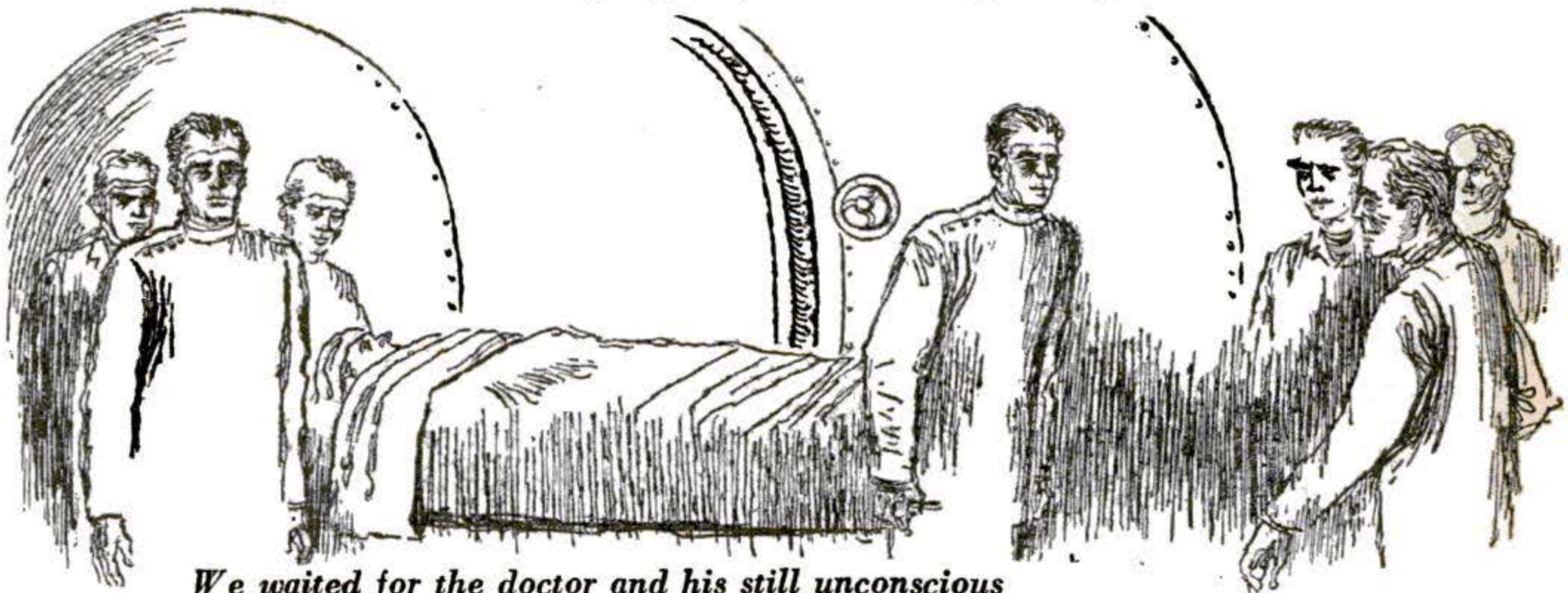
Our crew consisted of Tim Benton, Norman Powell, Ronnie Jordan, and me. The sick man was strapped to a stretcher against one wall; with him was a doctor who did nothing except look anxiously at his watch and give his patient an injection from time to time.

There was nothing to do while the *Morning Star* swept outward on the long curve that would bring her to the Space Hospital. Very slowly, earth was receding behind us. It no longer filled almost half the sky. Already we could see far more of its surface than was possible from the Inner Station. Northward, the Mediterranean crept into view; then Japan and New Zealand appeared over opposite horizons.

And still the earth dwindled behind us. Now it was a sphere at last, small enough for the eye to take in at one glance.

We were fifteen thousand miles above the earth, swimming into the path of the Space Hospital. Once again weight returned with the roaring rockets. There was one prolonged burst, then a series of short corrections. When it was all over, Commander Doyle unstrapped himself from the pilot's seat and drifted over to the observation port. His instruments told him where he was far more accurately than his eyes could, but he wanted the satisfaction of seeing for himself. I also made for a port.

Floating in space beside us was what seemed to be a great crystal flower, its face turned toward the sun. At first I could not judge its true scale or how far away it was. Then, through the transparent walls, I could see little figures moving around. The station must be at least five hundred feet in diameter.



We waited for the doctor and his still unconscious patient to go through the connecting tube first.

As we slowly drifted closer, I could see people gathering in the observation decks and glass-roofed wards to watch our arrival. For the first time, it occured to me that this flight of the *Morning Star* really was an event. All radio and TV networks would be covering it. As a news story, it had everything—a race for life and a gallant effort by a long-retired ship.

The rocket tractors came fussing up to us and towropes started to haul us in. A few minutes later the air locks clamped together. We waited for the doctor and his still unconscious patient to go through the connecting tube first, then went to meet the crowd waiting to welcome us.

Hospitals are usually rather depressing

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After a rapid conference with the unhappy pilot, Commander Doyle ordered: "Get me the nearest Relay Station. I'm taking over."

places, but this one was different. Few of the patients were seriously ill, though down on earth most of them would have been dead or disabled, owing to the effect of gravity on their weakened hearts. Many were eventually able to return to earth, others could live only on the moon or Mars, and the severest cases had to remain permanently on the station. The hospital was a huge place, ablaze with sunshine, and had almost everything that could be found on earth—everything, that is, that did not depend on gravity.

It seemed we would have to wait two days before we could go back to the Inner Station, because there was no earthbound ship until then. Of course, we could have made the return trip in the *Morning Star,* but Commander Doyle vetoed this.

"I don't mind tempting providence once," he said, "but before the old lady makes another trip, she's going to be overhauled and the motors tested. Combustion-chamber temperature was starting to rise unpleasantly on our final approach."

Before the ferry rocket arrived to take us home, we had the satisfaction of knowing that our mission had been successful. The patient was off the danger list, and had a good chance of complete recovery.

THE ferry rocket had been diverted from its normal run between the Observatory Stations. Its control cabin was much like that of any other spaceship, but from the outside the vessel looked peculiar. It had been built in space and, of course, had no streamlining or fins. The cabin was roughly egg-shaped, and connected by three open girders to the fuel tank and rocket motors. Most freight was not taken inside, but simply lashed to what were appropriately called "luggage racks," a series of wire-mesh nets on struts. For stores that had to be kept under normal pressure, there was a small hold with a second air lock just behind the control cabin.

I was watching the pilot's fingers flying across the position-finding calculator keyboard, when suddenly he froze over his desk. Very carefully, he pecked at the keys to set up his calculations again. An answer came up, and the pilot stared as if unable to believe it. Then he loosened himself from the seat straps and moved to the nearest observation port.

I was the only one who noticed. There was another port near me and I headed for it. Out there in space was the earth, toward which we were slowly falling.

Then an icy band seemed to grip my chest and I stopped breathing. By this time, I knew, earth should be appreciably larger as we dropped in from the orbit of the hospital. Yet unless my eyes deceived me, it was smaller than I had last seen it.

I looked again at the pilot, and his face confirmed my fears.

We were heading out into space.

"Commander Doyle," said the pilot. "Will you come here a minute?" The commander left his bunk and headed for the control desk. There was a rapid conference with the unhappy pilot; then the commander ordered: "Get me the nearest Relay Station. I'm taking over."

It was a quarter of an hour before anyone explained things to me, a quarter of an hour of furious activity, radio calls, and lightning calculations. Then Norman Powell took pity on my ignorance.

"This ship's got a curse on it," he said in disgust. "The pilot made the one navigation error you'd think impossible. He should have cut our speed by point nine miles a second. Instead, he applied power in exactly the wrong direction and we've gained speed by that amount. So instead of falling earthward, we're heading out into space."

It was one of those things, like landing an aircraft with wheels up, that isn't as difficult to do as it sounds. Aboard a spaceship in free orbit, there's no telling in which direction and at what speed you're moving. Everything is done by instruments and

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calculations, and if a minus sign is taken for a plus, it's easy to point the ship exactly the wrong way before applying power.

Of course, one is supposed to make other checks to prevent such mistakes. Somehow they hadn't worked this time or the pilot hadn't applied them.

The extra speed we'd been given was enough to put us into an escape orbit. In other words, we were traveling so fast that the earth could never pull us back. We wouldn't know our exact path until HAVOC worked it out for us. Commander Doyle had radioed our position and velocity. We had to wait for instructions.

The situation was serious, but not hopeless. We still had considerable fuel—the reserve intended for the approach to the Inner Station. If we used it now, we could at least prevent ourselves flying away from earth, but we should then be traveling in a new orbit that might not take us anywhere near a space station. Whatever happened, we had to get fresh fuel as quickly as possible. The short-range ferry wasn't designed for long excursions and carried only a limited oxygen supply, enough for about a hundred hours. If help couldn't reach us by that time, it would be just too bad.

We had to wait nearly fifteen minutes before the computing staff on the Inner Station worked out our new orbit and radioed it back to us. Commander Doyle plotted our path while we watched.

"We're heading for the moon," he said, tracing with his finger. "We'll pass its orbit in about forty hours, near enough for its gravitational field to have quite an effect. With some rocket braking, we can let it capture us."

"Wouldn't that be a good idea?"

The commander rubbed his chin.

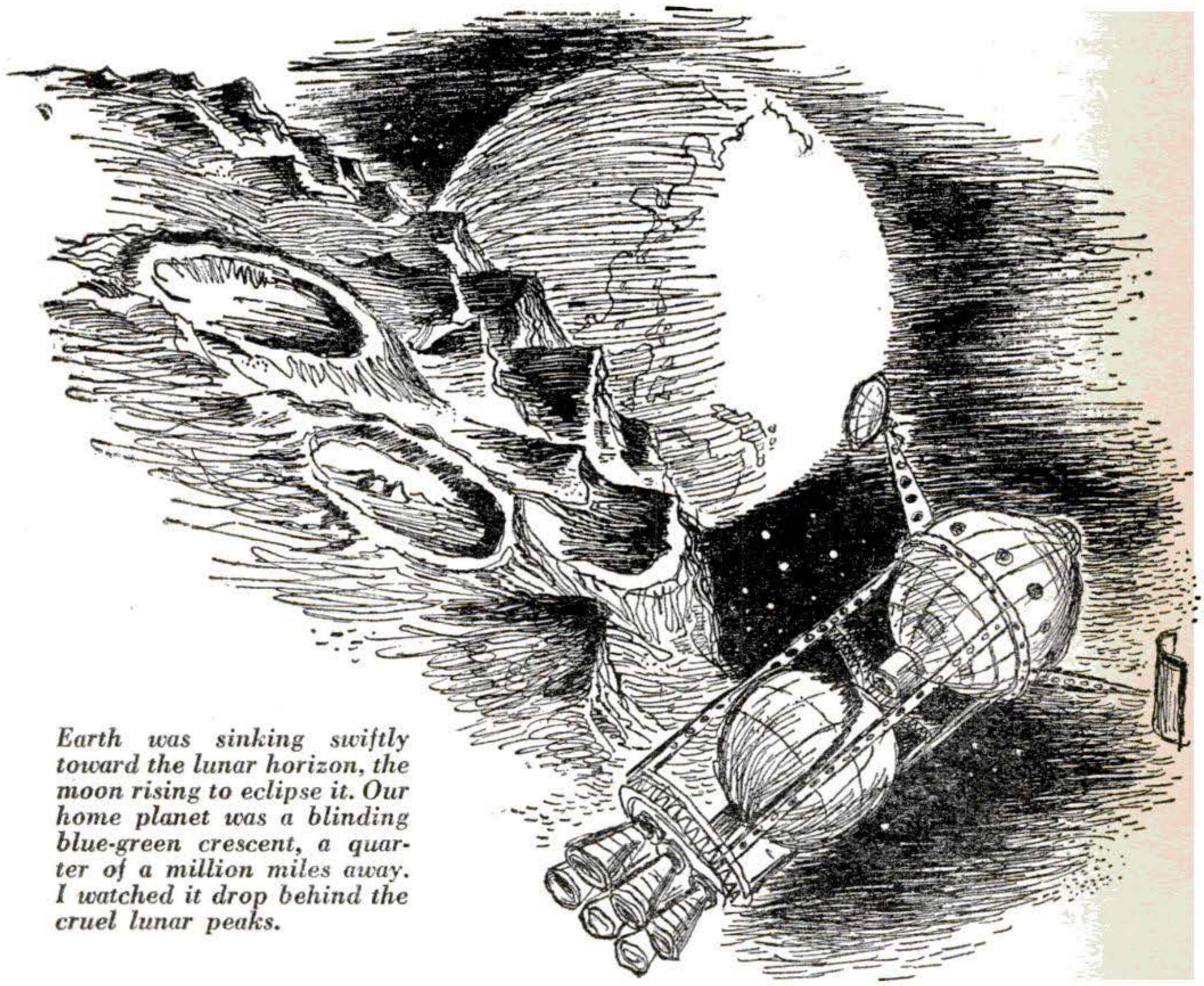
"I don't know," he said. "It depends on whether there are any ships on the moon that can come up to us."

"Can't we land on the moon ourselves, near one of the settlements?" asked Norman.

"No. We've not enough fuel, and the motors aren't powerful enough, anyway."

The cabin was filled with silence.

"The trouble is," said the commander at last, "that it's going to cost a fortune to get



Earth was sinking swiftly toward the lunar horizon, the moon rising to eclipse it. Our home planet was a blinding blue-green crescent, a quarter of a million miles away. I watched it drop behind the cruel lunar peaks.

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a ship up from the moon, just to match our speed and transfer a few tons of fuel. That's the obvious, brute-force answer."

The pilot's dejected face lit up.

"I've got it!" he said. "What's wrong with the launcher down in Hipparchus? That should be able to shoot us up some fuel."

The conversation grew animated and technical, and I was rapidly left behind. Ten minutes later some satisfactory conclusion had been reached. When all the radio calls had been made, I got Tim into a corner and threatened to keep bothering him until he explained what was going on.

"Surely, Roy," he said, "you know about the Hipparchus launcher?"

"That magnetic thing that shoots fuel tanks up to rockets orbiting the moon?"

"Of course. It's an electromagnetic track about five miles long, running east and west across the crater Hipparchus. Ships to be refueled get into an orbit round the moon, and at the right time the containers are shot up into the same orbit. The ship's got to do a bit of maneuvering to 'home' on the tank, but it's much cheaper than doing the whole job by rockets."

"What happens to the empty tanks?"

"That depends on the launching speed. Sometimes they crash back on the moon; there's plenty of room there. But usually they're given lunar escape velocity, so they just get lost in space."

"I see. We're going near enough to the moon for a fuel tank to be shot to us."

"Yes; they're doing the calculations now. Our orbit will pass behind the moon, about five thousand miles above the surface. They'll match our speed as accurately as they can with the launcher, and we'll have to do the rest under our own power."

"And when will all this happen?"

"In about forty hours."

Hour by hour earth dwindled and the moon grew larger in the sky ahead. There was very little to do, apart from instrument checks and regular calls to the space stations and lunar base. Most of the time was spent sleeping and playing cards.

Though I had often watched the moon through telescopes from earth and from the Inner Station, it was very different to see the great plains and mountains with unaided eyes. We were so close that all the larger craters were visible along the band dividing night from day. The line of sunrise had just passed the center of the disk, and it was early dawn down there in Hipparchus, where they were preparing for our rescue. Through the ship's telescope I peered down into the great crater.

The sunlight was slanting over its ruined walls, casting mile-long pools of inky shadow. Here and there upthrust peaks caught the first light of dawn and blazed like beacons in the darkness around them.

There were other lights in the crater shadows, arranged in tiny, geometric patterns. I was looking down on a lunar settlement. Now hidden in darkness were the great chemical plants, the pressurized domes, the spaceports and the power stations that drove the launching track. In a few hours they would be visible as the sun rose above the mountains, but by then we should have passed behind the moon and this side would be hidden from us.

And then I saw it, a thin bar of light stretching in a dead straight line across the darkened plain. I was looking at the floodlights of the launching track, ranged like lamps along an arterial road. The fuel tank would be waiting at the head of the track. If it had been daylight down there, I could have seen the actual launch. There would have been a tiny speck racing along the track, more and more swiftly as the generators poured their power into the magnets. It would leave the end of the launcher at over five thousand miles an hour, too fast for the moon ever to pull it back, and would sweep out into space to meet us.

Then the ship passed behind the moon, and I saw with my own eyes the land that had remained hidden from human sight until the coming of the rocket. It was, of course, much like the visible face.

I HAD almost forgotten earth when Tim drew my attention to it again. It was sinking swiftly toward the lunar horizon: the moon was rising to eclipse it as we swept along in our great arc. A blinding blue-green crescent, the South Polar cap almost too brilliant to look upon, the reflection of the sun forming a pool of fire in the Pacific Ocean—that was our home, now a quarter of a million miles away. I watched it drop behind the cruel lunar peaks until only the faint, misty rim was visible; then even this disappeared.

The fuel container was already on its way and on the correct orbit. The moon's gravitational field would curve its path and we would pass within a few hundred miles of it. Our job then was to match speeds by care-

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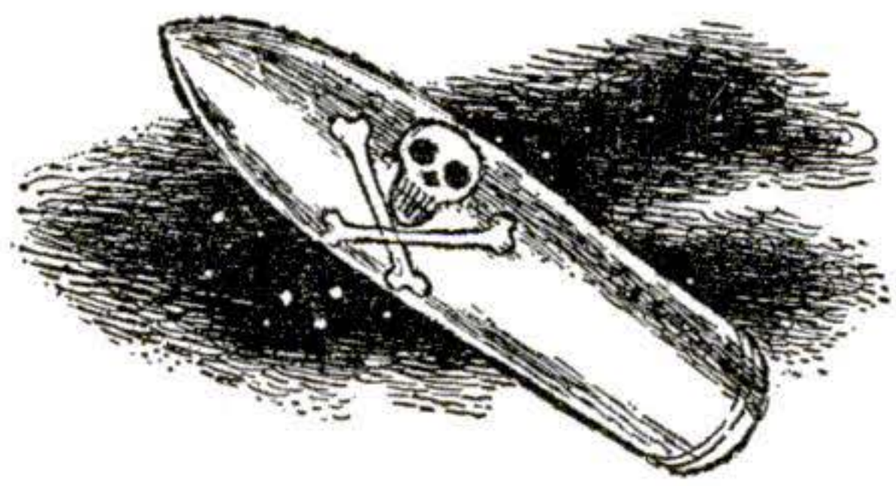
ful use of our remaining fuel, and when we had coupled up to the tank, pump across its contents.

"But just suppose," I said anxiously to Norman Powell, "that they score a direct hit on us! After all, the whole thing's rather like shooting a gun at a target. And *we're* the target."

Norman laughed.

"It'll be moving very slowly when it comes up to us, and we'll spot it in our radar. So there's no danger of a collision. By the time it is really close, we'll have matched speeds and if we bump it'll be like two snowflakes meeting head on."

We picked up the signals from the fuel container when it was still a thousand miles away, thanks to its tiny radio beacon. After this I kept out of the way while Commander Doyle and the pilot made our rendezvous in space. It was a delicate operation, jockeying a ship until it matched the course of the still-invisible projectile. Our fuel reserves were too slim to permit any more mistakes. Everyone breathed a sigh of relief when the stubby, shining cylinder was beside us.



Then the pattern glimpsed before swam back into view. Clearly painted on the missile was the skull and crossbones.

The transfer took only about ten minutes. As our pumps finished their work the earth emerged from behind the moon's shield. It seemed a good omen. We were masters of the situation and in sight of home again.

I was watching the radar screen when we turned on the motors again. The bright spot representing the empty fuel container drifted slowly to the edge of the screen. It was the only object near enough to produce a radar echo in the thousand-mile-diameter globe swept by our beams.

About to switch off the radar screen, I saw a faint spark of light at extreme range. It vanished as our beam moved into another sector of space, and I waited until it had swept through the complete cycle, wondering if I'd been mistaken. But the spark reappeared in the same position. I stopped the beam sweep so that it locked on the distant echo. It was just under five hundred miles away, moving very slowly. Then I called Tim, on the chance that it was a large meteor.

Tim thought I'd picked up our discarded fuel container again. But he soon saw that it was in a different part of the sky, and his skepticism vanished.

"It must be a spaceship," he said. "If it is, it'll be carrying a radio beacon."

He turned our receiver to the beacon frequency, but without result. Norman now joined us, looking over Tim's shoulder.

"If it's a meteor," he said, "let's hope it's a nice lump of platinum. Then we can retire for life."

"Don't worry," said Tim, "no one's ever found anything except iron in meteors."

"How big would it have to be to produce a radar echo this bright?" I asked.

"You can't tell," said Tim. "A spaceship could produce a signal as small as that, if seen end on."

"I think I have it," said Norman suddenly. "And it isn't a meteor. You look."

He had been searching with the telescope, and I took his place. Against a background of faint stars a roughly cylindrical object, lit by sunlight, was slowly revolving. It was streamlined and had a pointed nose, more like an old-time artillery shell than a modern rocket.

Commander Doyle stared through the telescope for a long time after we called him. Finally he remarked: "Whatever it is, we'd better look at it and make a report."

Our ship spun round in space as we began the course correction. The rockets fired for a few seconds, our new path was rechecked, and after several shorter bursts, we began to edge toward the mysterious object under the steering jets alone. Meanwhile it was impossible to use the telescope, so when I next saw my discovery it was only a hundred yards beyond our port.

It was a rocket of some kind. Since it was only about ten feet long, it might be one of the automatic reconnaissance missiles sent out in the early days of space-flight. Commander Doyle didn't think so, because as far as he knew they'd all been accounted for, and it had none of the radio and TV equipment such missiles carry.

It was painted a very bright red, an odd color, I thought, for anything in space.

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There was some lettering on the side but we couldn't make out the words at this distance. As the projectile slowly revolved, a black pattern on a white background came into view, but went out of sight before I could interpret it.

"I don't like its looks," Tim Benton said. "Red's the sign of danger."

"Don't be an old woman," scoffed Norman. "If it was a bomb, it certainly wouldn't advertise the fact."

Then, with the thing less than fifty feet away, the pattern I'd glimpsed before swam back into view.

Clearly painted on the slowly approaching missile was the symbol of death—the skull and crossbones.

Commander Doyle must have seen that ominous warning as quickly as we did, for an instant later our rockets thundered briefly. The crimson missile started to recede once more into space. At its closest approach, I had read the words below the skull and crossbones:

WARNING!
RADIOACTIVE WASTE!
ATOMIC ENERGY COMMISSION

"Wish we had a Geiger counter," said the commander thoughtfully. "Still, by this time it can't be very dangerous. But we'll all have a blood count when we get back."

"How long do you think it's been up here, sir?" asked Norman.

"Not this one. But it will be when we report it. Good work, Malcolm!"

I was pleased at the compliment, but still a bit worried that we'd received a dangerous dose of radiation. Luckily my fears proved groundless.

We discovered, a good while later, the history of this stray missile. The Atomic Energy Commission finally admitted the dispatch of a waste container in 1981 that had been intended to crash on the moon but missed. Astronomers had a lot of fun working out how the thing got into its orbit.

DESPITE this incident, we were only a few minutes behind schedule when we swept into the orbit of Relay Station Two, the one over the middle of Africa. It consisted of a flat, rectangular latticework, with one side facing the earth. Covering this face were hundreds of small, concave reflectors that beamed radio signals to the planet beneath, or collected them on the way up.

We cautiously approached the back of the station. A pilot who let his ship pass in front of it was very unpopular, as he might cause a temporary failure on thousands of circuits, while blocking the radio beams. For the whole of the planet's long-distance services and most radio and TV networks were routed through the Relay Stations. As I looked more closely, I saw that there were two other sets of radio reflector systems, aimed not at earth but sixty degrees both ways from it. These were handling the

The great revolving drum of the Residential Station slowly expanded ahead as Tim maneuvered the Skylark closer.

"They started getting rid of dangerous waste this way in the 1970's. Nowadays we know how to deal with by-products of the atomic piles, but then there were a lot of isotopes they couldn't handle. Rather a drastic way of getting rid of them!"

"I've heard about these waste containers," said Tim, "but I thought they'd all been collected."

beams to the other two stations.

We spent only twelve hours at the Relay Station, while our ship was overhauled and reprovisioned. The living arrangements were much the same as on the Inner Station.

We did get a brief glimpse of the main switch room. There were acres of dials and colored lights. Soft voices, in every language, came through the loudspeaker. We saw foot-

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ball games, string quartets, air races, ice hockey, puppet shows, grand opera—the world's entertainment, all depending on three tiny metal rafts hanging in space.

Not all the Relay Station's business was concerned with earth, by any means. The interplanetary circuits passed through them. If Mars wished to call Venus, it was sometimes convenient to route messages through the earth relays by high-speed telegraphy. Because it takes several minutes for radio waves to bridge the gulf between even the nearest planets, you can't actually talk to someone on another world. (Except the moon—and there you have to put up with an annoying time-lag of three seconds before you get any answer.)

Our trip back to the Inner Station was uneventful and rather tedious. Nothing much had changed. Some ships had gone and others had taken their places. The other apprentices were waiting for us in the air lock. They gave the commander a cheer as he came aboard, but later there was a lot of good-natured kidding about our adventures.

I'd missed the ship that was supposed to take me home. The plan now was to send me over to the Residential Station and put me on the regular ferry, so that I'd be going to earth with passengers homeward bound from Mars or Venus.

I spent most of my last day aboard the station collecting autographs and souvenirs. At last everything was packed. There was one good-bye left to make.

Commander Doyle was sitting at his desk, just as I'd seen him first. I hoped that I'd not been too much of a nuisance and tried to say so. The commander grinned.

"I suppose you realize, Roy, that a good number of young men apply for jobs here and not many get them. The qualifications are too steep. Well, I've kept my eye on you and if, in a couple of years, you want to put your name down, I'll be glad to make a recommendation."

"Why, thank you, sir!"

The commander propelled himself out of his seat with his left hand, stretching out the right one toward me. As we shook hands, I again recalled our first meeting and suddenly realized that, though I'd seen him every day, I'd almost forgotten that Commander Doyle was legless.

I had a surprise on reaching the air lock. I had assumed that one of the ferry rockets was going to take me to the Residential Station. Instead, there was the ramshackle *Skylark of Space,* with Tim Benton and Ronnie Jordan as the crew.

The great revolving drum of the Residential Station slowly expanded ahead of us: the collection of domes and pressure corridors that had been my home for so long dwindled astern. Cautiously Tim brought the *Skylark* up to the axis of the station. Big jointed arms drew us slowly in until the air locks clamped together.

"Well, so long," said Ron. "We'll be seeing you again."

"I hope so," I said, wondering whether to mention Commander Doyle's offer.

I shook hands with them both, the doors folded back, and I went through into the flying hotel that had been my neighbor for so many days.

IT WAS late in the "evening" when I arrived aboard the Residential Station. Time here was geared to the cycle of nights and days down on earth. Every twenty-four hours the lights dimmed, a hush descended, and the residents went to bed. The sun might be shining, or in eclipse behind the earth—it made no difference here.

My room was just large enough to hol[illegible] bed, a chair and a washbasin. It was [illegible] strange to see flowing water again that [illegible] first thing I did was turn on the tap a[illegible] watch a pool form in the basin.

That first evening I spent enjoying an experience only gravity could make possible—taking a real bath, in water which didn't try to turn itself into a giant drifting raindrop.

I didn't sleep well my first night under gravity, even though I weighed only a third of what I'd been accustomed all my life. Breathing was difficult, and I had unpleasant dreams about climbing a steep hill with a load on my back. At last, however, I managed to doze off until a steward woke me for breakfast.

When I had dressed, I started to explore. The first thing to get used to was the fact that the floors were all curved. The reason for this was simple enough. I was on the inside of a giant cylinder that slowly turned on its axis. Centrifugal force, the same force that held the station in the sky, held me to the side of the revolving drum.

If you walked straight ahead, you could go right around the station and come back to where you started. At any point, "up" would be toward the central axis.

The station wasn't a single cylinder, but

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three, one inside the other. As you moved out from the center, weight increased. The innermost cylinder was the "One-Third Earth Gravity" floor, and being nearest the air locks was devoted mainly to handling passengers and luggage.

Surrounding this central cylinder was the more spacious "Two-Thirds Earth Gravity" floor. You passed from one floor to the other by elevators or by curiously curved stairways. It was an odd experience, for I was not yet accustomed even to a third of my earth weight. As I walked slowly down the steps, gripping the handrail firmly, I seemed to grow steadily heavier.

There were some small shops on the "Two-Thirds Gravity" deck, and I was exploring these when some Martian colonists came in. One was a fellow about my age.

"Hello," he said, "you weren't on the ship."

"No," I answered. "I've just come over from the other half of the station."

"I'm John Moore," the other said. "It's my first trip to earth."

"You were born on Mars?"

"That's right. I'm coming home to go to college."

It sounded strange to hear that phrase "coming home" from someone who'd never set foot on earth.

For the rest of my short stay in the Residential Station I spent most of my time with John Moore. We had so much to talk about that the hours spent waiting for the ferry passed quickly. Life on Mars was as novel to me as life on earth was to him. John had a fine collection of photographs showing the great pressure-domed cities and colored deserts.

Before you could go down to earth, you were supposed to spend a twelve-hour quarantine period on "Full Earth Gravity" floor—the outermost of the station's three decks. So once again I went down one of those curving stairways, my weight increasing with every step. When I had reached the bottom, my legs felt very weak and wobbly. I could hardly believe that this was the normal force of gravity under which I had passed my whole life.

John had come with me, and felt the strain even more than I did. This was three times the gravity of his native Mars, and twice I had to stop him from falling as he tottered unsteadily about. The third time I failed, and we both went down together. For a while we sat on the thick rubber flooring (the designers of the station had known where it would be needed!) and got up strength for another attempt. This time we didn't fall.

There were nearly fifty passengers crowded into the "One-Third Gravity" floor waiting to disembark by the earth ferry. This was the biggest spaceship I had ever been inside. There was one large cabin for the passengers, with seats in which we were supposed to remain strapped during the trip. We waited nearly an hour before everyone was aboard and the luggage stowed away. Then the loudspeakers told us to stand by for takeoff.

Three sharp notes gave us the last warning. Five seconds later the motors opened up gently, quickly increasing power to full thrust. I saw the Residential Station fall swiftly astern, its great, spinning drum dwindling against the stars. Then the maze of girders and pressure chambers that housed so many of my friends went by.

After a surprisingly short period, the motors cut out again. We had shed all the speed necessary, and gravity would do the rest. The ship was now pointing against the direction of its orbital motion and had to be swung round to enter the atmosphere nose first. The pilot did it with the low-powered steering jets at the wing tips. From where I sat I could see the short columns of mist stabbing from the nozzles, and very slowly the stars swung around us.

We were still almost five hundred miles above the Equator, moving at nearly eighteen thousand miles an hour, but slowly dropping earthward. The coast of South America flashed by in seconds. Ahead lay the huge jungles of the Amazon. Now the great river was widening as we shot above its course. I saw that a big storm was raging below, all in silence as we raced overhead.

"A tropical storm," I said to John. "Do you ever have anything like that on Mars?"

"Not with rain, of course," he answered. "But sometimes we get bad sandstorms. And I've seen lightning twice."

"What, without rain clouds?"

"Oh, yes, the sand gets electrified."

The storm was now far behind us, and the Atlantic lay smooth in the evening sun. On the horizon I could see a band of shadow swiftly approaching as we hurtled into twilight. In mid-Atlantic we lost the sun, and at almost the same moment heard the first whisper of air along the hull.

It was an eerie sound that made the hair rise at the back of my neck. After the

silence of space any noise seemed wrong. But it grew steadily from a faint, distant wail to a high-pitched scream. More than that, it was tearing at the ship, slowing it down. There was a faint but steadily increasing tug from our straps. It was like sitting in a car when the brakes are being slowly applied.

We were no longer in a spaceship but an airplane. I was looking out into the darkness when I saw a faint red glow beneath me. At first, because there was no sense of perspective or distance, it seemed at an immense depth below the ship. I could not imagine what it might be. Then I realized, with a shock, that this ominous red glow came from our wing. The heat of our passage through the atmosphere was turning it cherry red.

I stared at that disturbing sight for several seconds before deciding that everything was quite in order. Nevertheless I was glad when we emerged into daylight once more. The glow was no longer visible. Besides, the sheer splendor of the sunrise, which we were approaching at ten thousand miles an hour, took away all other sensations.

A cluster of lights along the coast of East Africa told us that we were heading out over the Indian Ocean again. By now the pilot would be coming down the radio beam.

NEXT MONTH . . .

POPULAR SCIENCE MONTHLY *will tell you —not in fiction—how scientists are planning to send out artificial meteors as the first man-made things to scout planetary space.*

I never knew the actual moment when we touched down. At one instant we were still airborne, at the next the lights of the runway were rolling past as the ship slowly came to rest. I was back on earth.

We moved slowly away from the ship toward the waiting transport vehicles. I looked up once more at the starlit sky. John Moore was waiting patiently behind me, clutching the door handle of the bus. He saw me looking up and followed my gaze.

But he was staring into the east, where the first hint of dawn glowed. Among the stars was a brilliant ruby beacon—Mars.

I stared into that beckoning light and knew that I was going to disappoint Commander Doyle after all. The space stations were too near home. My imagination had been captured by that little red world glowing against the stars. When I went into space again, the Inner Station would be only a milestone on my outward road. END

He was staring into the east, where a ruby beacon glowed. Then I knew the space stations were too near home, and only a milestone on the road to the stars.

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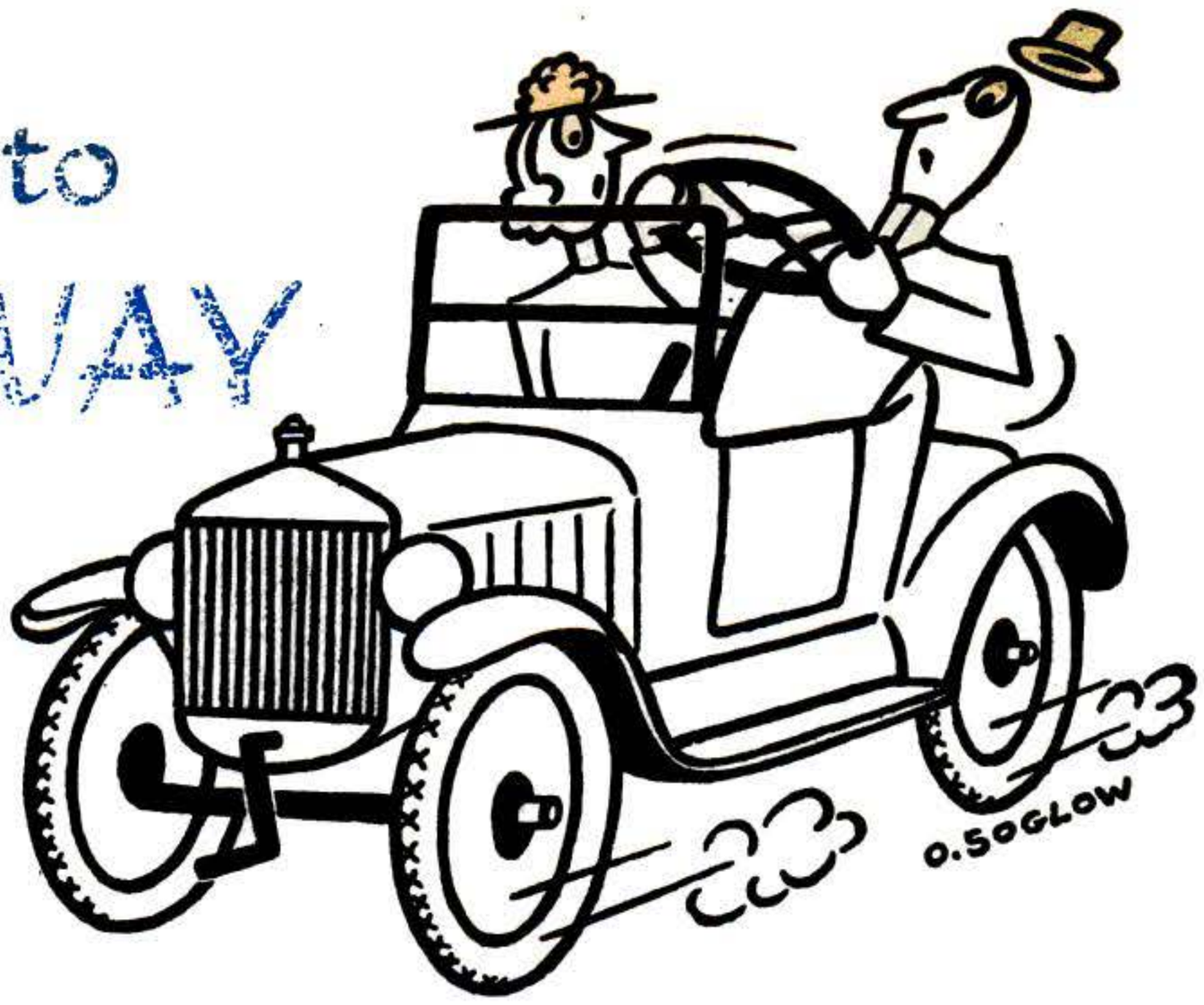
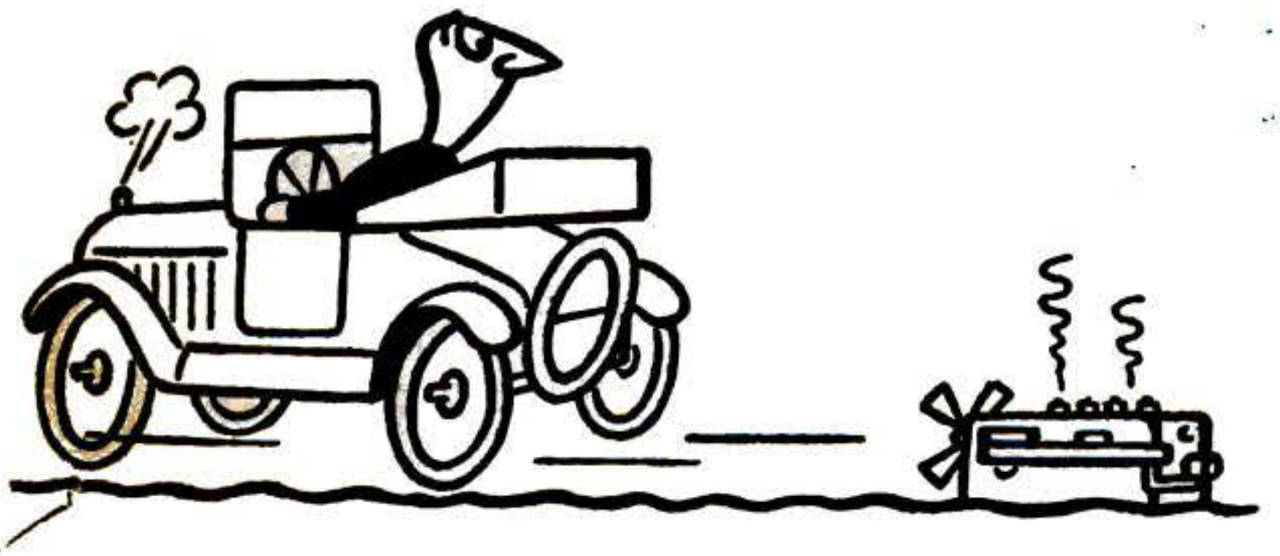
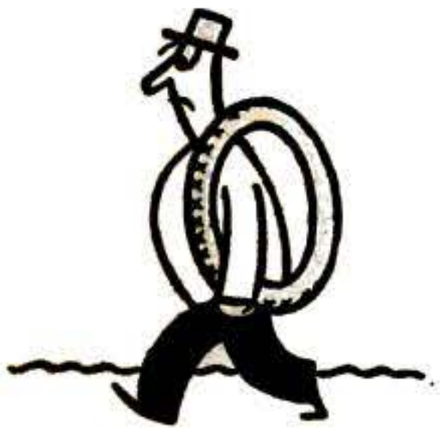
We're going to GIVE AWAY our old [illegible]



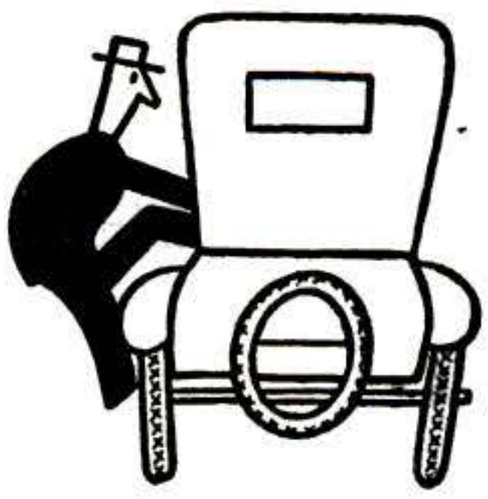


Ever own—or drive—a [illegible] If you did, you probably are still amusing your friends with the story about some funny experience you had with it. Maybe your story would amuse other readers of POPULAR SCIENCE MONTHLY, too.



For [illegible] And to the person who sends in the best one by August 1, we will also give away the 1925 Model T we bought as practically junk, restored to perfect running order, and told about in a series of articles last February, March and April.

Your story of "My Funniest Experience With a Model T" should be written—preferably typewritten—on one side of a single sheet of paper. We expect to get too many to acknowledge or return the ones we don't use. But if we print yours, you'll get a check for 10 bucks—and maybe our Model T.



Send it in—by August 1—to: Model T Editor, POPULAR SCIENCE MONTHLY, 353 Fourth Avenue, New York 10, N. Y.

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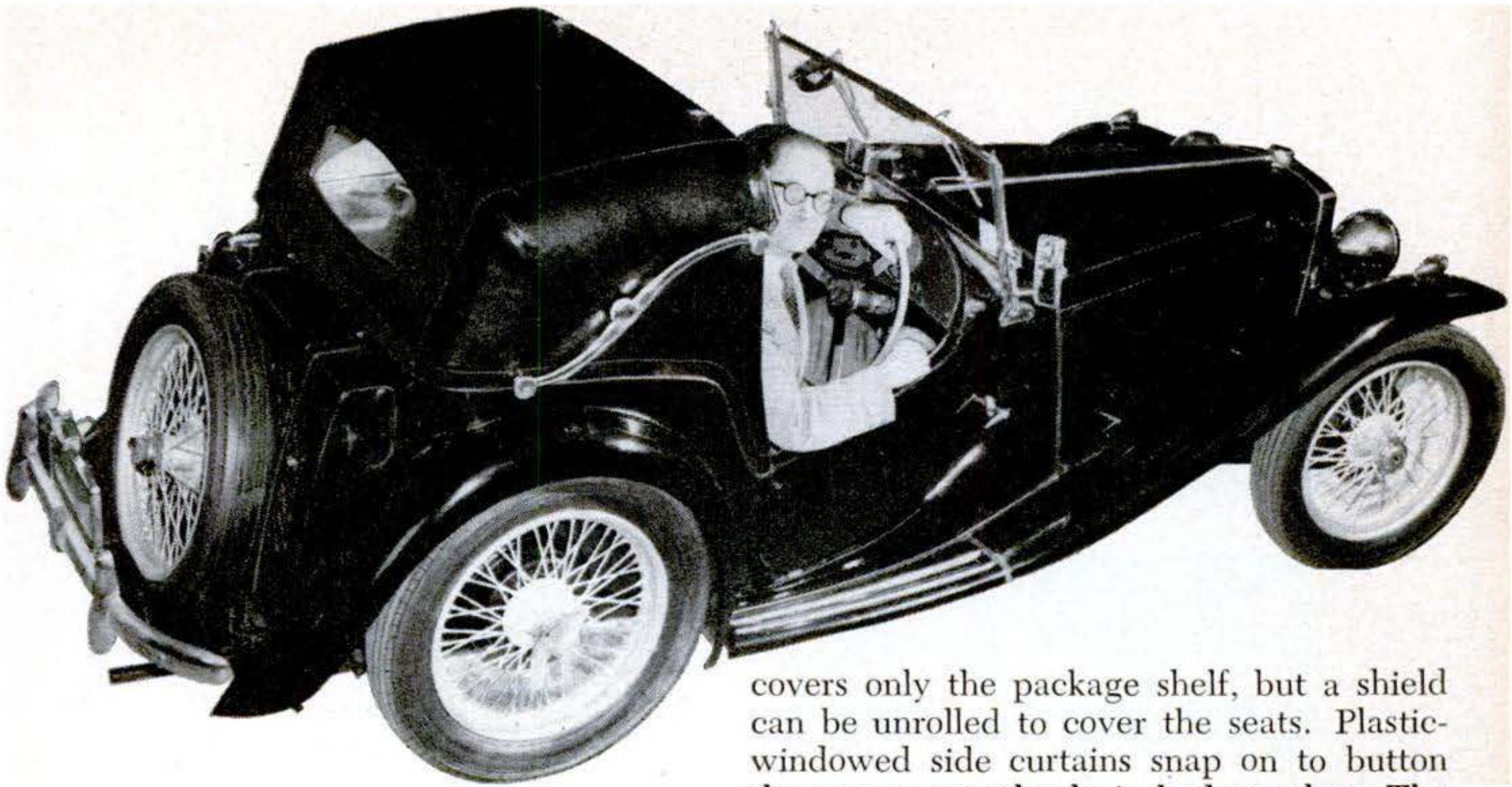
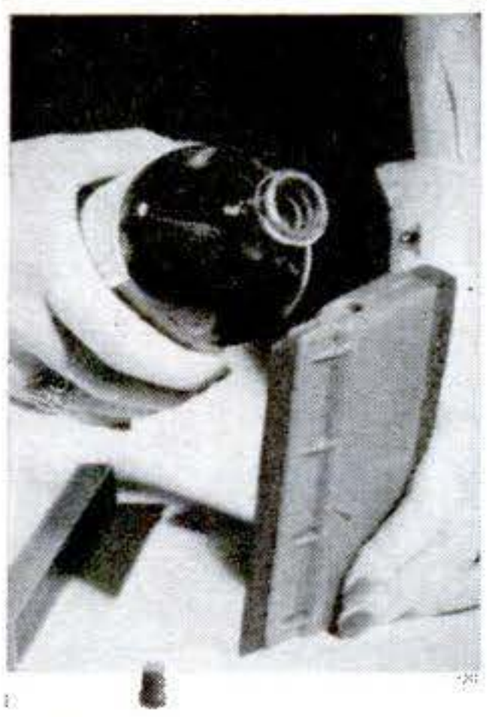


Home, James—in an MG

IF THAT looks like a limousine that shrank, you're close to right. Actually it is an MG customized into a landaulet. The rigid top covers only the package shelf, but a shield can be unrolled to cover the seats. Plastic-windowed side curtains snap on to button the car up completely in bad weather. The whole works lifts off for sport driving. Fred Strauss of Richmond Hill Auto Top, New York City, built the unit for Bob Rischarde of the Bronx.

All-in-One Window Washer



FILL this plastic flask with a cleaning agent and the liquid seeps through a felt pad at one end to do a fast window-washing job. A squeegee at the other end strips the glass dry. There's no pail to lug, no cloth to wring out. Haines, 301 S. 7th St., Minneapolis, sells it.

Watch Keeps Tabs on Race Cars

A NEW Swiss watch for sports-car fans does a lot more than tell the time of day. It's a 1/5-second stop watch; checks car speed over a measured mile from 41 to 120 m.p.h.; records the elapsed time for a day's run up to 12 hours; and has a special unit counter to record the gallons of gas used on a trip. The Auto-Graph is sold in the U. S. by Abercrombie & Fitch, NYC.

Drill Powers Grain Elevator

A FARMER can hang up the shovel and do a lot of scoop work with a new grain elevator run by a ½-inch electric hand drill. The long conveyor tube has a worm at one end that digs in and moves 400 bushels of shelled corn or grain seed in an hour. Designed by the Tri-County Mfg. Co., Taylorville, Ill., it is now undergoing farm tests.

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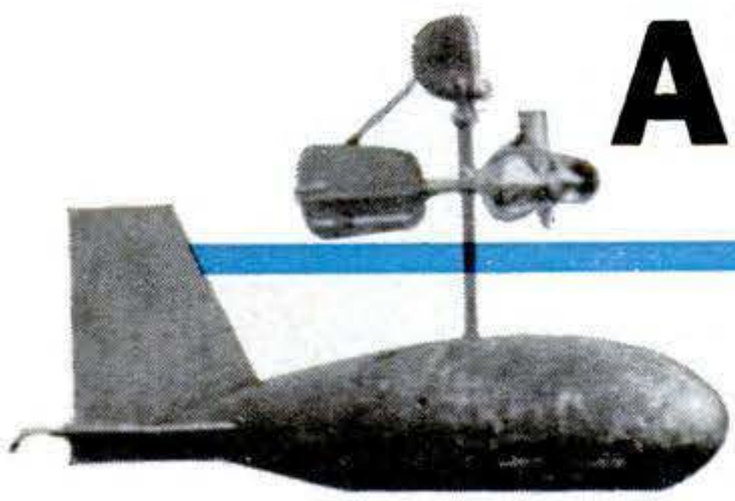
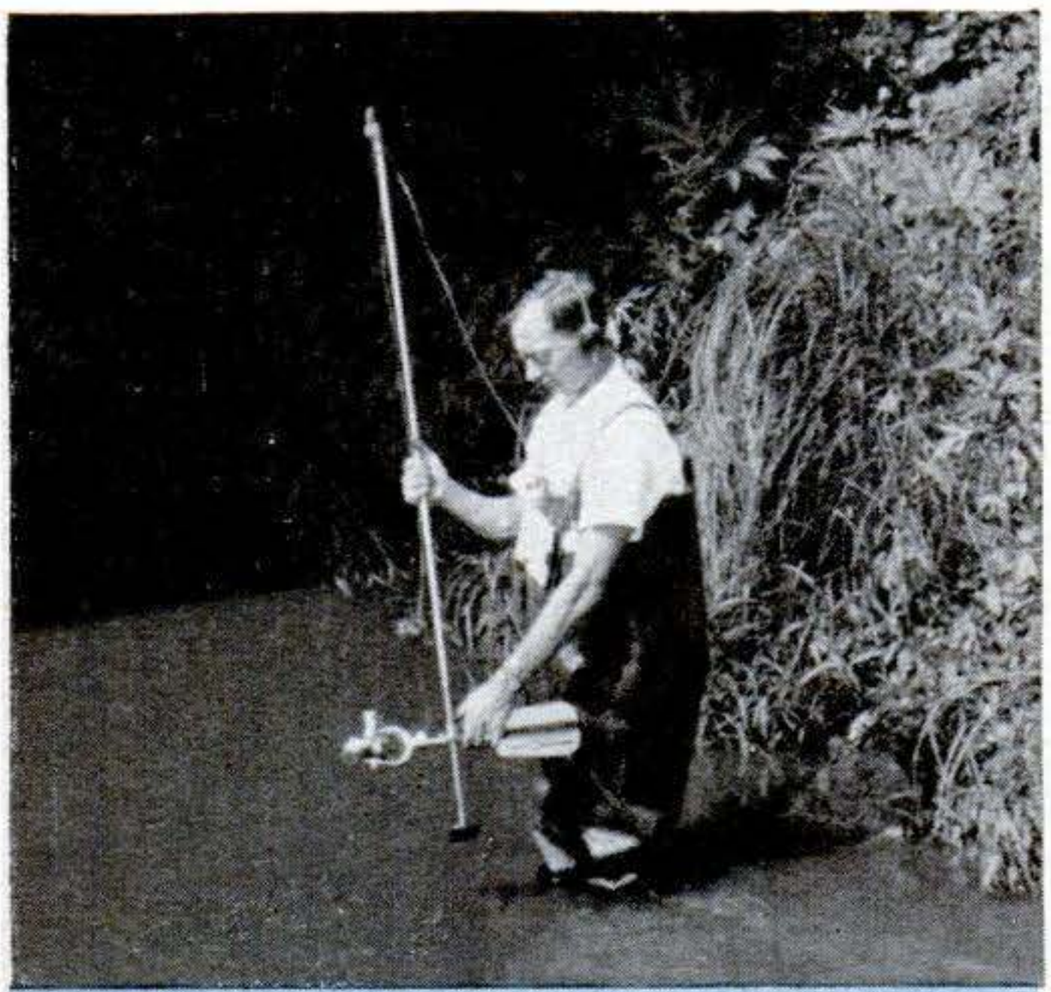
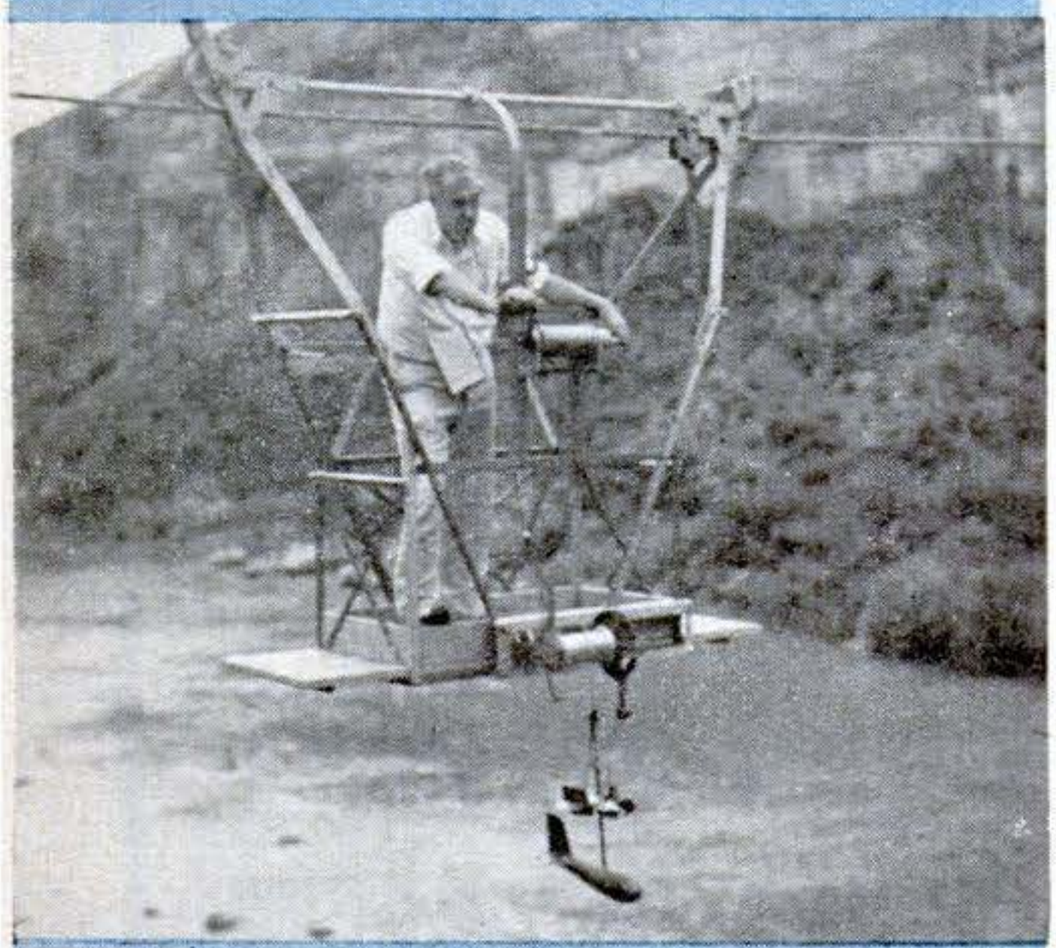
River Speedometer Aids Flood Control





WADERS AND "FISH ROD" are the equipment used for measuring the flow of a really small stream—such as the Kaskaskia River, near Bondville, Ill.



AERIAL CABLE-CAR RIG, set up for job, carries engineer measuring the speed of Salt River near Chrysotile, Ariz. Readings must be made every 50 ft.

IF YOU come across a gent leaning over a bridge rail dropping what looks like a baby torpedo into the river below, don't bother to holler for the FBI. He's not a dangerous saboteur, but a government scientist trying to find out how much water is rushing to the sea.

Take a good look at his "torpedo" and you'll find it is solid lead, with instruments sprouting from its back. It reports depth and current speed. Since the river width is known, it's easy to figure how much water is moving past every hour.

This is vital information, not just to trout fishermen but to a lot of other people. Engineers must know water flow to plan flood-control work and power dams. Farmers must know how much irrigation water to count on. River pilots must figure channel depths, mayors must plan for drinking water, utility men must reckon the head ready to turn generators. And industry gulps water for everything from steel to whiskey.

Taking Water Inventory

To meet all these demands, the U. S. Geological Survey is taking inventory on our water resources. Stream heights are gauged automatically at 6,500 points. Since the men with the lead torpedo make tables showing the current speed that goes with each water level, you can figure how much water is moving just from the level alone.

The heavy lead torpedo carries instruments to the right depth and holds them against the current. The gauge looks like a wind gauge, but its whirling cups measure moving water instead of air. Every fifth whirl they send a click over a telephone line to the earphones of an operator above. He measures the water speed by counting the clicks in a given time interval.

As shown in the accompanying pictures, the survey men use all sorts of gear to get their torpedo to water. But they're proudest of their newest rig—the truck-mounted crane at top of facing page. END

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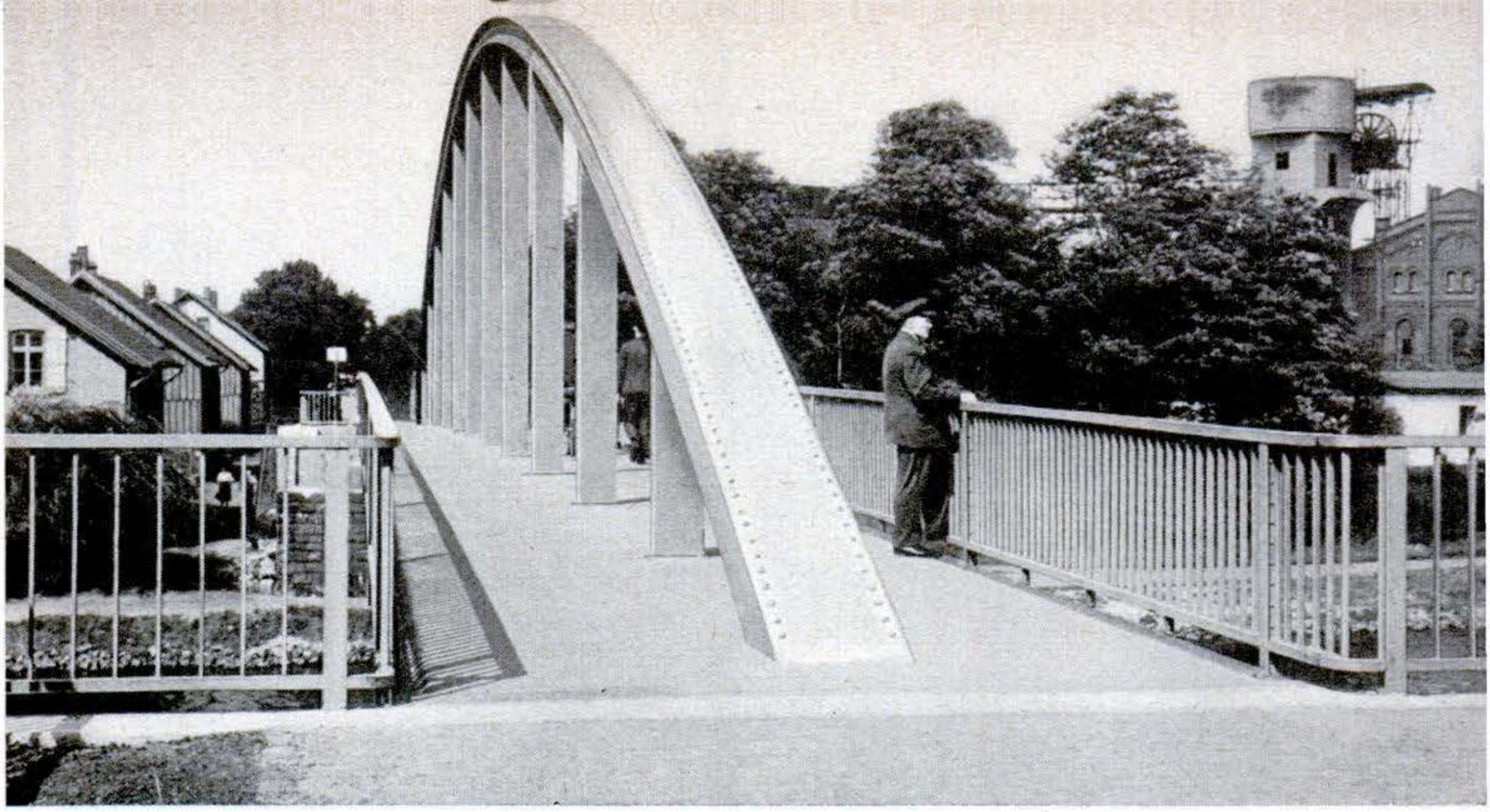
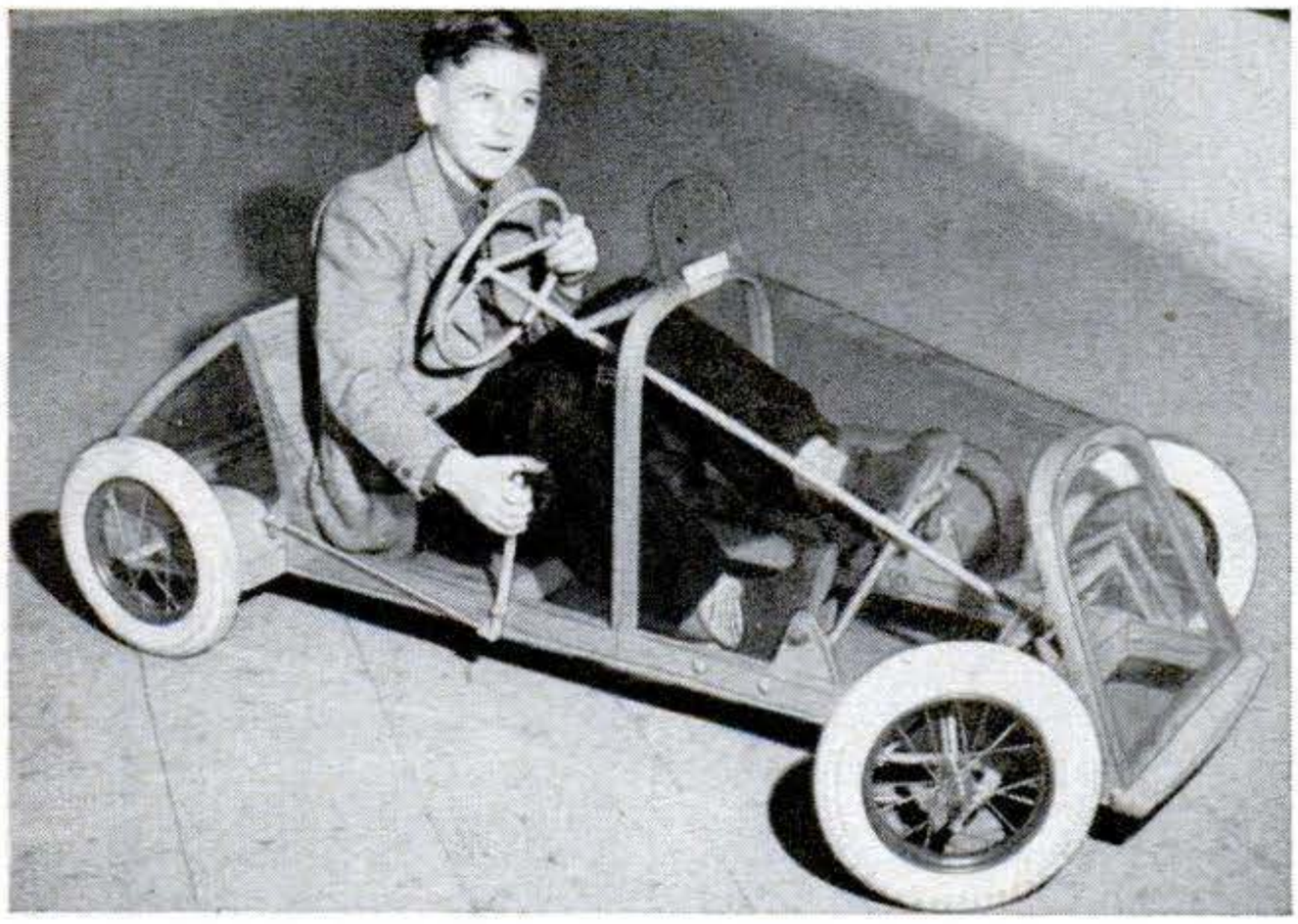
NEWEST RIG, used on Mississippi, is mounted on baby car that is small enough to go on sidewalk of many bridges. Crane can be rotated and adjusted to any angle by manually operated fluid jack. Rear take-off transmits engine power to reel through hydraulic drive. When engine idles, little torque develops in drive and gauge can be dropped by releasing reel brake. Speeding engine develops enough torque to raise gauge. Thus operator can move from station to station along bridge without disengaging take-off. Built on a commercial vehicle by U.S. Geological Survey, rig costs about $1,900.

ROWBOAT clamped to line across river is used where there's no bridge and river's too wide to be spanned by cable rig. Here Mississippi overflow channel is gauged during flood.



Single Arch Supports Rainbow-Shaped Model Bridge

LIKE a man straddling a stream, the footbridge above spans the Rhine-Herne Canal in Germany. A single footing at each end supports the arch from which the walkway is suspended. Winner of a design contest, and claimed to be the first single-bow bridge ever built, it is the model for a larger span to be erected in Sweden.



The Germans Make Plastic Cars, Too

THIS de luxe racer steers just like a full-size car, each front wheel turning on its own pivot. The all-metal chassis has a transparent plastic hood and there's a bumper like a cowcatcher to take care of head-on collisions. The drive is pedomatic—the rear wheels chain-driven by a foot crank. Equipped with a hand brake and rolling on wire wheels like the big foreign sport cars, the little runabout sells, in Germany, for about $45.

That's Not Salami

YOU can freeze this new chemical ice in refrigerator (left), then use it to keep picnic food cold. Called Sno-Gel, it thaws to a jelly.

Two-Way Flash

A NEW flashlight bulb made by GE has two filaments that can be turned on independently to throw a spot or flood of light.

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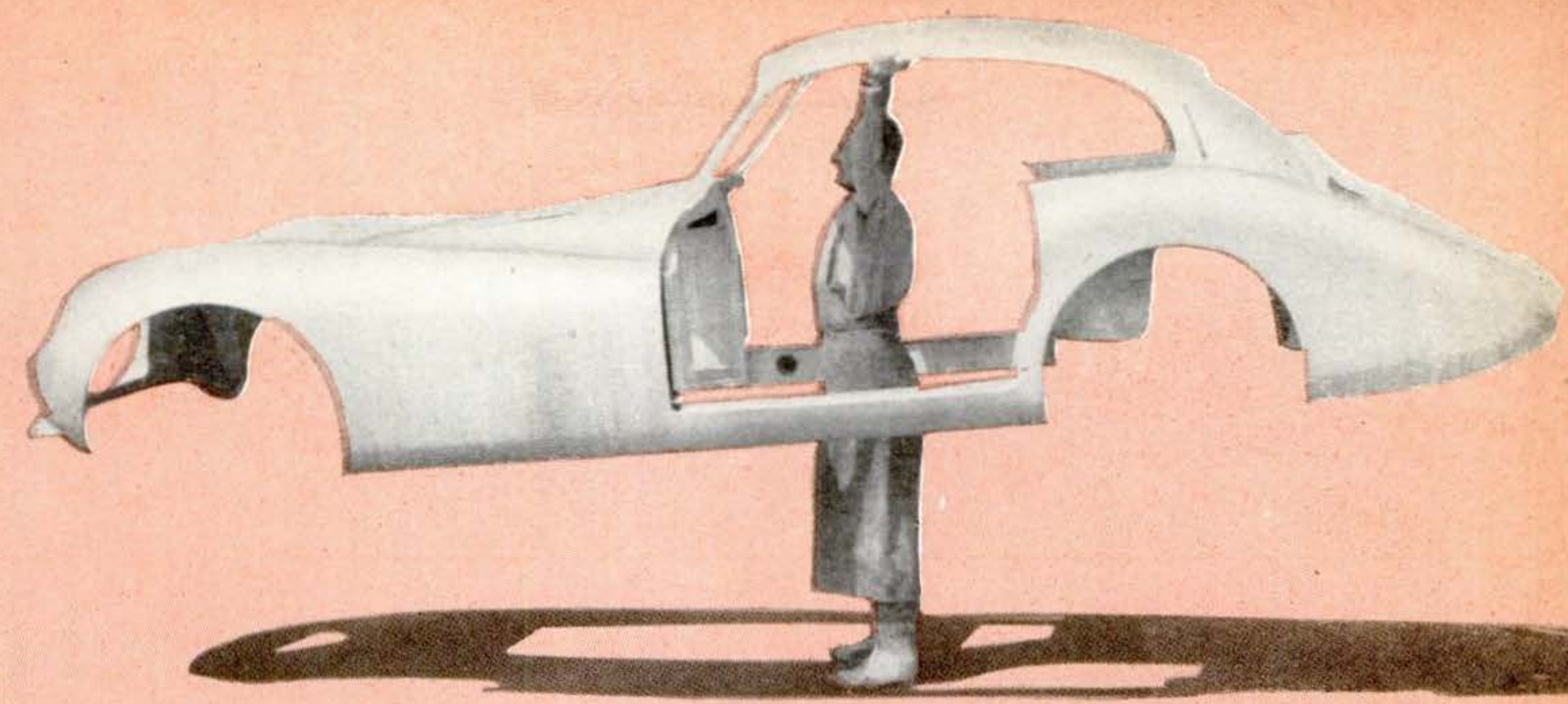


New Magnesium Car Is Lighter Than Plastic

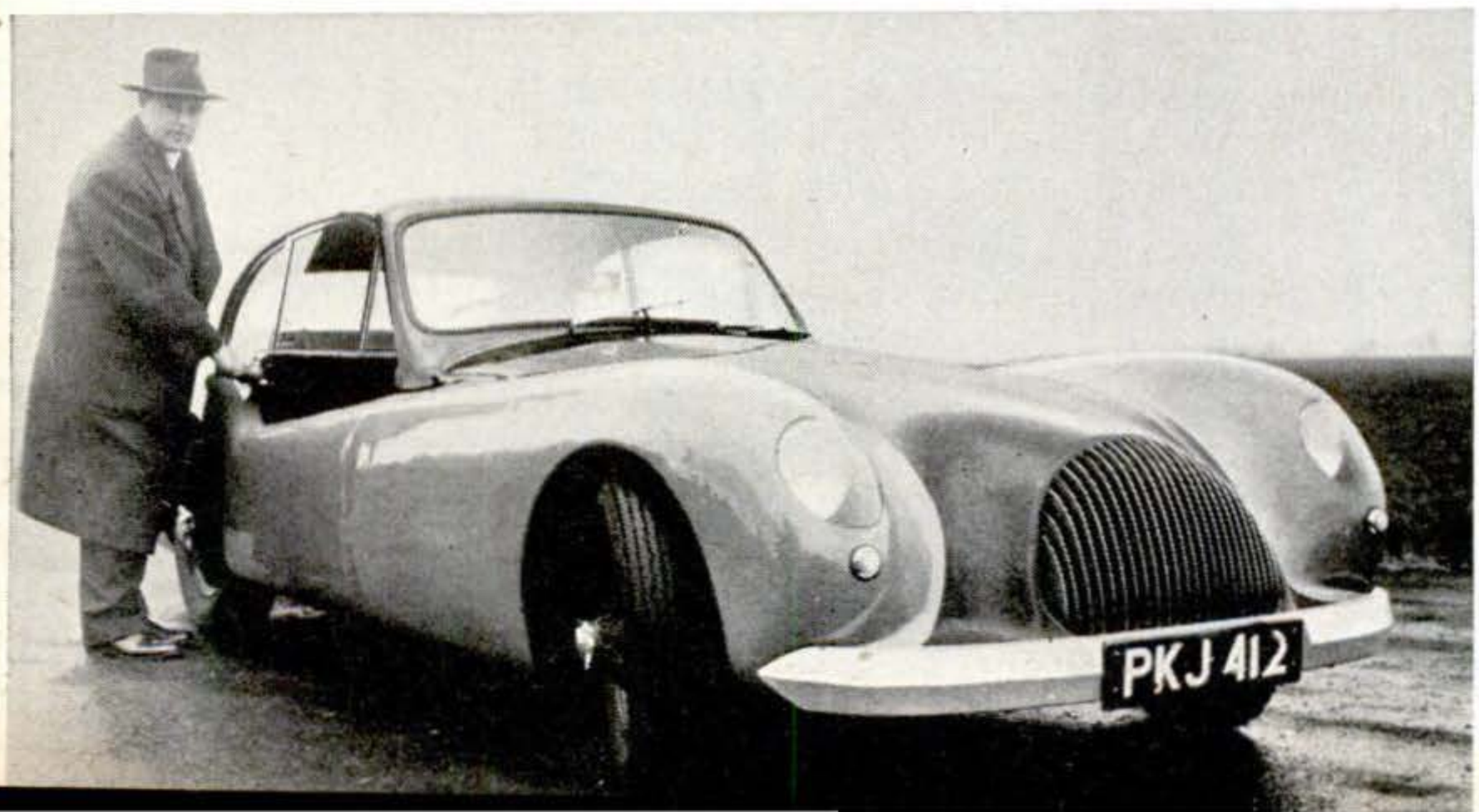
British sports-car body is rigid as steel, less than half the weight of plastic, and can be built on today's assembly lines.

By William McGaffin

HUNTING for something lighter than steel, American car makers are taking a growing interest in plastic bodies.

"But they are overlooking an even better bet," says R. J. Cross, managing director of Essex Arrow, Ltd., in England. Since last July, Cross has been driving a car with a magnesium body.

An old hand at designing and fabricating magnesium products, Cross made gas tanks and other aircraft parts of the lightweight wonder metal for British



S-X MAGBODY, which weighs only 132 pounds, is mounted on Allard chassis powered by Mercury engine. Folded magnesium sheeting takes place of reinforcing pillars and the entire body is welded in one piece. Designer R. J. Cross towers over 56-inch experimental model.

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MAGBODY CAR in background could travel from Maine to California on 150 gallons of gas which this featherweight magnesium tank will store for a British flying boat.

Spitfires during World War II. Now his plant at Gravesend is turning out products ranging from hush-hush defense items to hospital beds.

Cross believes his magnesium car body, which he calls the S-X Magbody, is the only one in existence. But he is sure that there will be a lot of them around in days to come.

Uses Mercury Engine

The S-X Magbody is the result of 15 months of experimental study and design. Without doors it weighs a mere 132 pounds. A similar shell, made of steel, would tip the beam at 528 pounds. No exact figure can be given for a comparable plastic body, but Cross says reinforcing members would put the weight about halfway between steel and magnesium.

Cross mounted the S-X Magbody on a conventional Allard chassis powered by a Mercury engine. The car has a 112-inch wheelbase, a bumper-to-bumper length of 16 feet, and is 69 inches wide and 56 inches high. Its total weight, including numerous accessories, is 2,683 pounds.

That makes a relatively small difference in over-all weight between the S-X Magbody car and one with a plastic or steel body. But Cross says this is only the beginning. He is certain that in time we will see an engine and chassis made of magnesium too. He points out that American manufacturers are already exploring the possibilities of making gearboxes, back axles and differential housings of magnesium, and that, section for section, it is cheaper than cast iron or cast steel. By substituting magnesium wherever possible, Cross figures, a car the size of a Cadillac, weighing from 4,000 to 5,000 pounds, could be pared down to 2,500 pounds.

Cross feels that both in England and the United States there is too much optimism over plastic car bodies. He maintains that a magnesium body is not only practical, but lighter than an equally strong plastic body.

"True," he points out, "plastic would be approximately 15 percent lighter than magnesium on a section-for-section basis.

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But you can't produce the same sections in both. With plastic you don't go below one-tenth of an inch on large, unsupported panels without using heavy reinforcing material. On the other hand, magnesium lets you use .032-inch thickness."

In cost, he adds, the magnesium body can compete with plastic and might prove cheaper. Magnesium ingot sells at 25.4 cents a pound, and car-body gauges range from 50 cents to $1.20 a pound in the United States. Reinforced plastic runs from 50 cents to as much as $1.75 a pound.

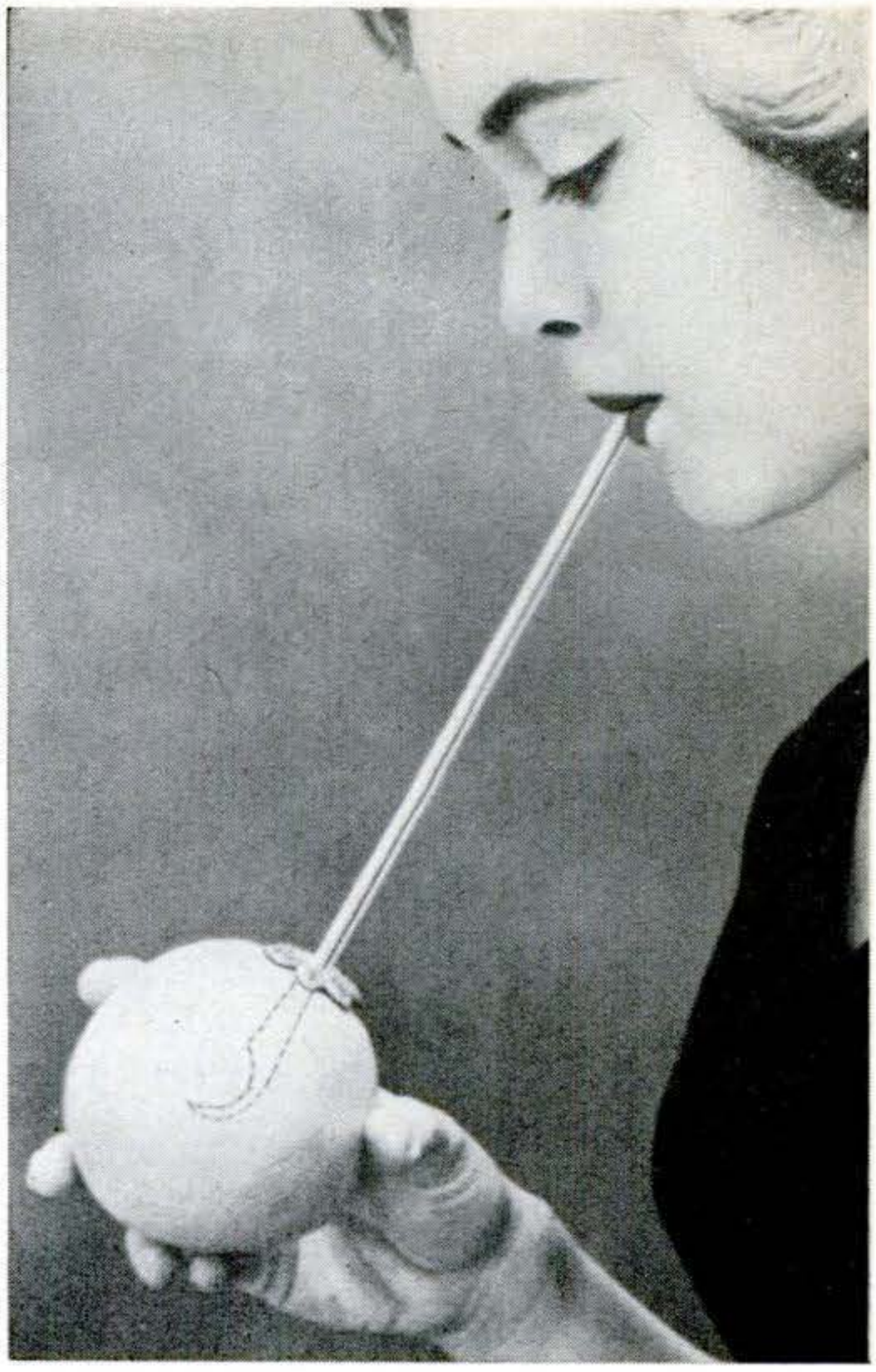
There are other things to consider. The auto industry's craft practices could be switched over to produce magnesium bodies with only minor changes, Cross says. Plastic molding and thermosetting techniques, however, would call for radical changes in equipment and personnel.

Cross believes that, design for design, there would be little difference between the crash-resisting properties of a plastic and a magnesium body, but on a strength-weight basis the magnesium body should have an edge.

Less Weight Means Quick Stops

With the new alloys now available, he argues, a magnesium body should suffer less damage in a collision than a steel one. Not only would the lower weight of a magnesium body make it possible to stop a car more quickly; the metal itself would be more rigid than the light-gauge steel now used.

Cross isn't worried about magnesium supplies keeping up with mass-production demands. American car makers have pointed out that in 1951 magnesium production was only 40,000 tons, compared to 105 million tons of steel. He answers that magnesium is only one-fourth as heavy as steel. Car-body manufacturers can't take full advantage of that, but they can consider 40,000 tons of magnesium the equal of 120,000 tons of steel. What's more, given the incentive, primary producers of magnesium could expand production from five to 10 times. END



Plastic Straw Taps Vitamin C

THERE'S no dribble when you plunge the tip of this plastic Sip-Stik into the blossom end of an orange, lemon or grapefruit, and sip the juice through the straw. Unlimited Design, NYC, makes it.

Sliding Sun Visor Aids Pilots

GLARE-REDUCING plastic visors, which can be moved quickly from one spot to another on a monorail track above the cockpit windshield, are being installed on United Air Lines' Mainliners and Cargoliners.

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The File Clerk Gets a Lift

THIS file clerk does all her work sitting down. A hydraulic lift raises desk, chair and clerk as high as five feet alongside the circular file. The unit also rolls forward or backward. The Wassel Organization, Inc., Westport, Conn., makes it.

Power Stick Fells Trees

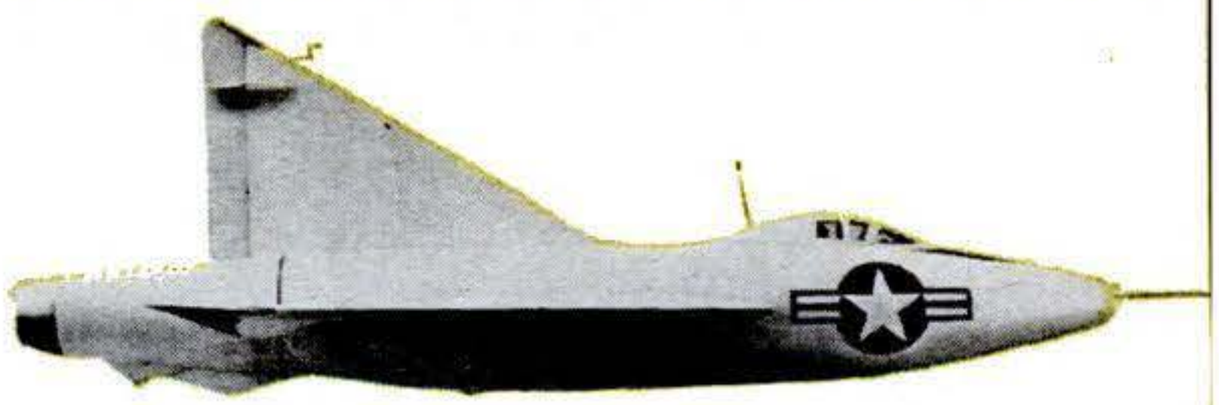
A ONE-CYLINDER engine drives a 12-inch chain saw to cut down trees up to five inches in diameter. An interchangeable cutting head converts the tool to a power scythe for mowing weeds. Hoffco, Inc., Richmond, Ind., is the maker.

How You'll Fly in 1975

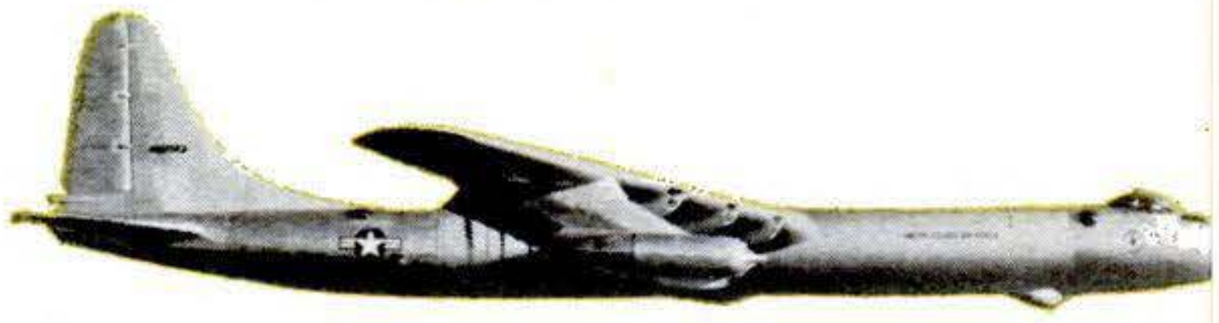
WHEN you buy a flight ticket in 1975, you will step aboard a transport with a long, slim fuselage and wings so far back that they look almost like extra-large tail surfaces. And you will fly almost as fast as sound.

Military aircraft, too, will change drastically. Interceptors and bombers—those flown by human pilots—will streak to their targets at velocities much faster than sound. And even these swift jets will give way to rocket-powered missiles that can hit an enemy on the other side of the seas.

What you see on these pages are dramatizations of the shapes to come—dreamed up by Consolidated Vultee experts. But engineers generally wrap their dreams around a hard core of fact. Ten years ago, supersonic speed, now commonplace, was only a gleam in an optimistic engineer's eye.



FIRST DELTA-WING PLANE ever flown, the XF-92A, above, was forerunner of the F-102 interceptor. It appears cumbersome compared with shapes to come.



TODAY'S INTERCONTINENTAL BOMBER can fly halfway around the world. Power from jets helps piston engines for short bursts of speed. It will top 435 miles per hour.

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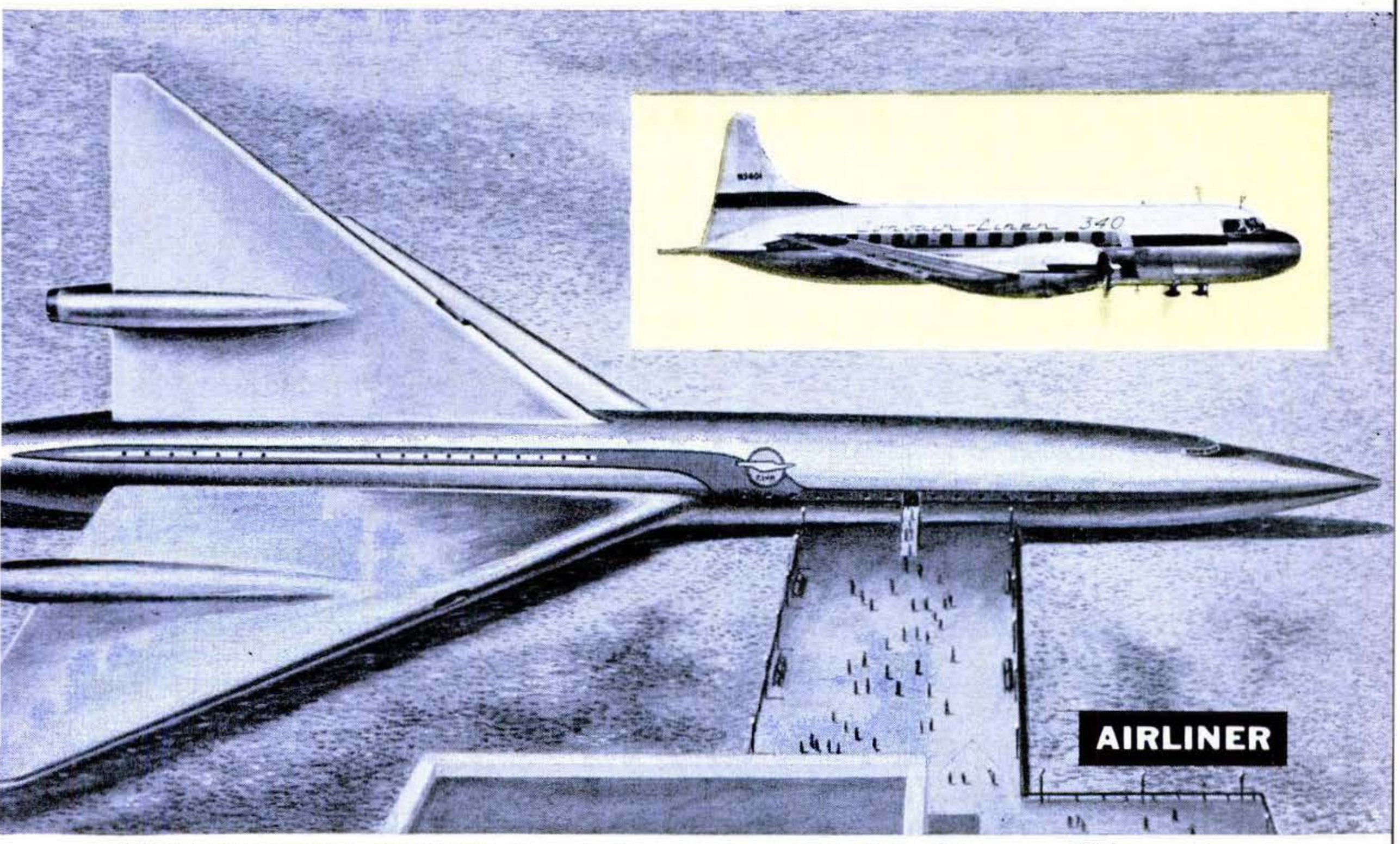
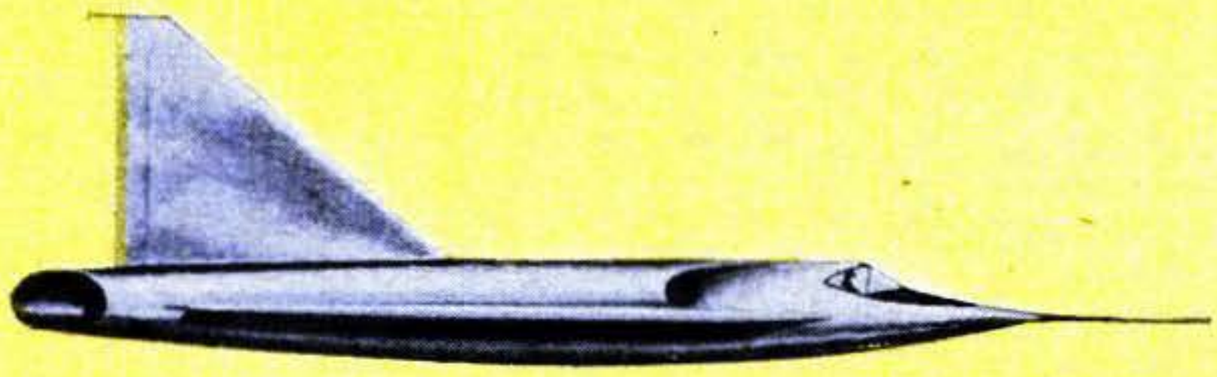
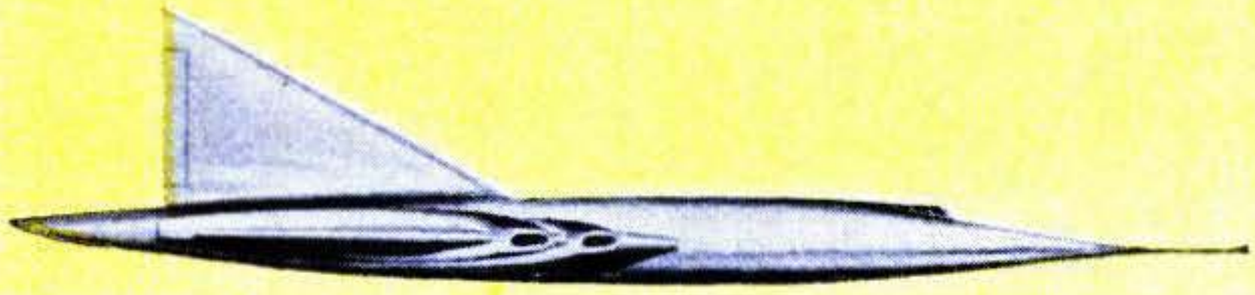


GIANT DELTA-WING SEAPLANE, shaped like a toy dart, is the dream design that Consolidated Vultee engineers expect will supplant present Convair 340 for passenger service. The transport of the future would have a jet engine in vertical stabilizer as well as in each of the sharply swept wings, but is planned for near-sonic, not supersonic, speeds.

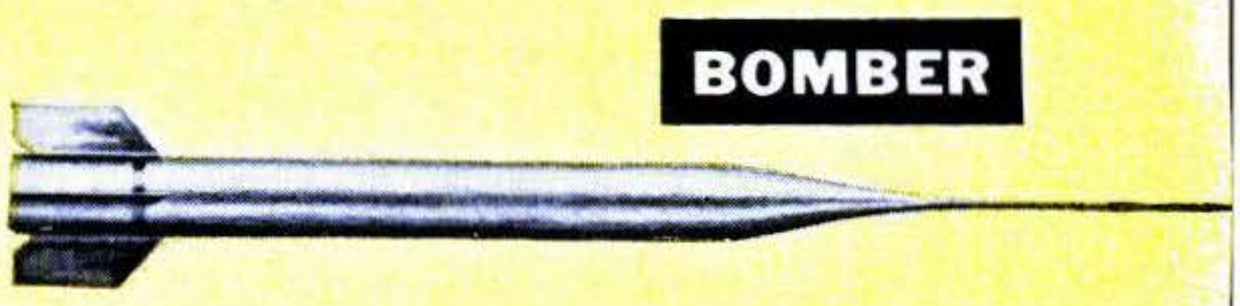


FUTURE INTERCEPTOR, flying from land or water, will reach very high speeds. Rake ahead splits air in supersonic flight. External gingerbread has disappeared.

INTERCEPTOR MISSILE with large control fins would permit faster maneuvering to hit incoming bomber. Ground-fired, it could fly at speed of several thousand miles an hour.



ALL TOMORROW'S MANNED BOMBERS may be propelled by jets alone. Unlike the B-36 at left, some may be able to take off and sit down on land or water.



GUIDED MISSILE able to cross an ocean may replace bomber aircraft. Wings may disappear completely and fins operated by electronic brain guide missile to target.

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Champ Gas Savers Show How to Run Your

They've got a quick formula for matching a light car against a heavy one—and a bag of driving tricks for boosting mileage.

By Andrew R. Boone

FELLOW from Detroit recently wheeled a new Ford six 1,206 miles from Los Angeles to Sun Valley, Idaho, on less than 45 gallons of gas—27 miles to the gallon.

How close can you come to getting that from your bus?

Not very close, probably, for this fellow's light-footed performance won him first place in the carefully staged annual Mobilgas Economy Run. His car was tuned up like Fritz Kreisler's fiddle, and he had driven the exact route ahead of time—mapping every stop light, plotting the pitch of every slope, planning just how he'd drive every mile to squeeze the last ounce of push from every thimbleful of gas.

Without figuring things quite that fine, you can have a lot of fun—and maybe learn something that will save money—by staging your own economy run.

Gets 27 Miles to Gallon

SWEEPSTAKES WINNER Les Viland in Ford six saves gas coasting downhill in Idaho during drive to victory in Economy Run.

For tips on how to do it, I rode along on this year's Economy Run—a 27-hour grind, strictly refereed by the American Automobile Association, that carried 26 cars into four states and over five mountain crests in three days at an average speed of close to 45 miles an hour.

All cars in the run were stock '53 four-door metal-top sedans with front-wheel tread of at least 53 inches. Picked by the AAA without warning from salesroom floors, warehouses and assembly lines, they were entered in four classes, known in the industry as low price, low medium, upper medium and high, plus a special class for lightweights. There were also, for the first time, separate divisions for overdrive and automatic transmissions.

Figure It on Weight

AAA experts know you can't match a heavy car against a lightweight on straight gas mileage. The light car would take the honors. So they match all on the basis of weight. Formula: gross vehicle weight in tons (including load allowed for gas and oil, driver and his relief, and two Caltech engineering students acting as AAA observers) times the official mileage divided by gallons of fuel consumed. The result is called "ton-miles per gallon."

In staging your own economy run, you'll want to find out two things: your own car's mileage and how it stacks up against neighbor Jim Jones's snappy new job.

Figuring car mileage is a cinch. Fill 'er up, clear to the top of the neck. Make a note of the speedometer reading. Keep tabs on gas purchased through a half-dozen refills. On the last filling,

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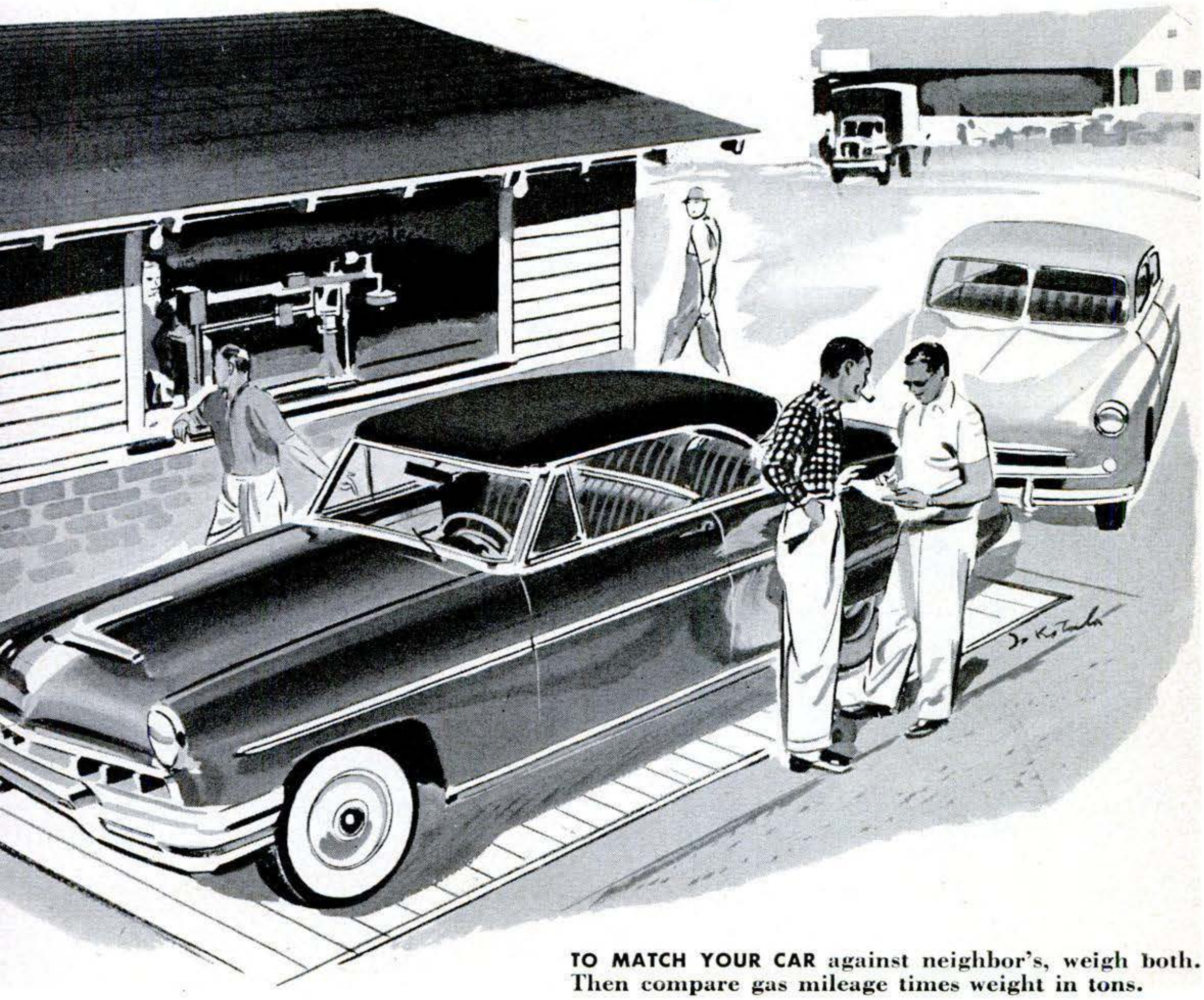
Own Economy Run



TO MATCH YOUR CAR against neighbor's, weigh both. Then compare gas mileage times weight in tons.

level off again at the top of the neck. Add up the gallons purchased (not counting the first complete fill). Subtract the starting from the finish mileage. Divide the miles by the gallons burned. You've got the average car miles per gallon.

But a run requires competition. Jim's new car may be larger or smaller, heavier or lighter. That's where ton-mileage comes in. Compute the results just the way the AAA calculates the figures. This procedure is simple, too. Both of you fill up at the same station. To make the competition as good a test as the pros', keep refilling until both of you have covered about 1,200 miles, in town and on the road.

For accuracy, top off your tanks at the same station, alongside the same pump island, pointing in the same direction. At start and finish, jump up and down on the rear fenders. That will discharge air.

Say you're driving a Ford V-8 Crestline. It hits the scales at 3,400 pounds, full of gas and with you at the wheel. Jim's pushing a Chrysler New Yorker—4,200 pounds, including Jim and fuel. At the end of the test, you each multiply actual gas mileage by car tonnage. Suppose Jim averages 15 miles to the gallon:

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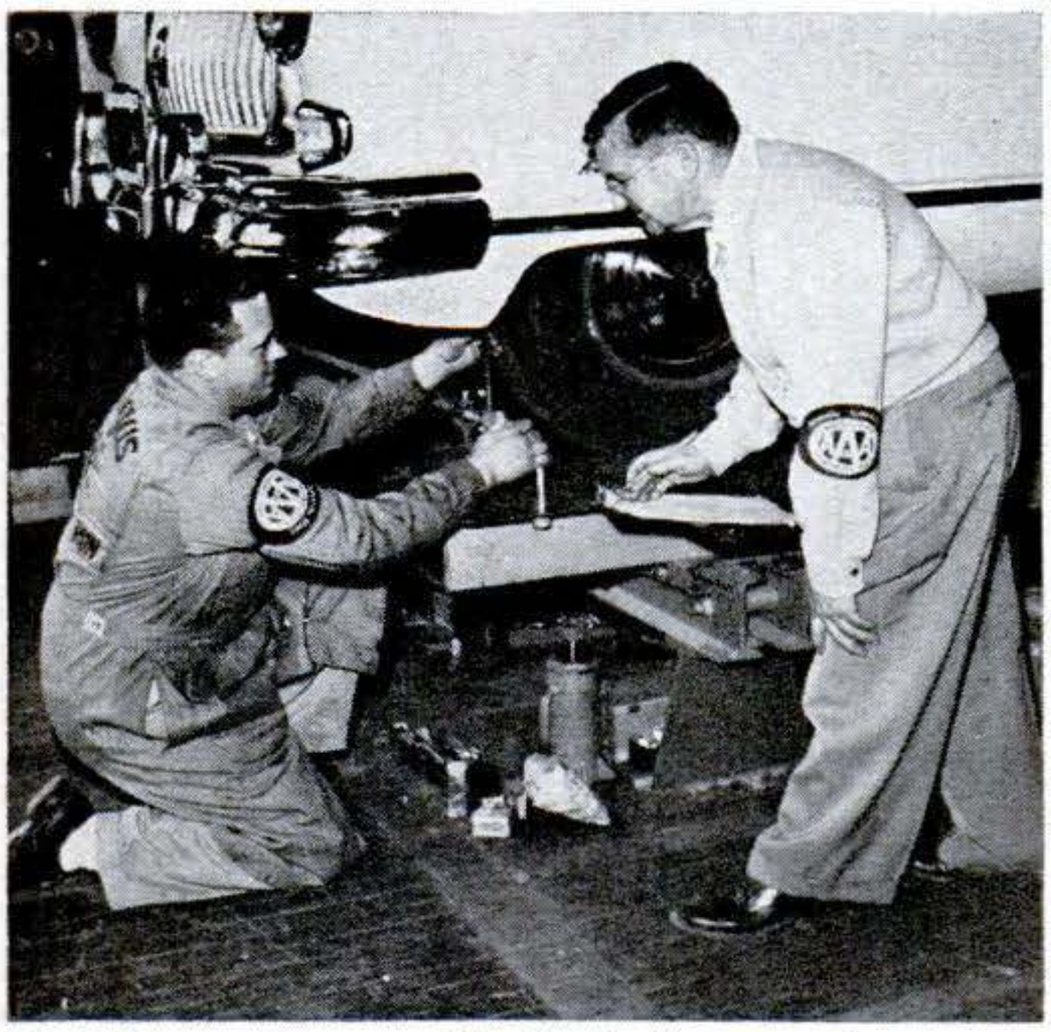
JOCKEYS WEIGH IN for Mobilgas Economy Run. Each car carried driver, relief driver, two AAA observers—and enough lead weights in trunk to bring its total load to 750 lb.



PHYSICAL CHECKUP: Technical supervisors test wheel alignment of Nash Ambassador before start of run. Seventy seals on engine and mechanical parts barred tampering en route.

How They Ran

MAKE & MODEL	DRIVER	MILES PER GAL.	TON-MI. PER GAL.
LOW PRICE (Standard & Overdrive)			
*Ford Mainline 6	Les Viland	27.0335	56.7028
Studebaker Champion	Vic Del Coma	26.8622	50.8770
Ford Mainline 8	Bill Hooks	22.5183	48.5494
Hudson Super Jet	Rolfe S. Lowdon	25.4279	47.9825
Plymouth Cranbrook	Eddie Bishop	22.8301	46.9501
**Chevrolet Two-Ten	Pete Novotny	Disqualified**	
LOW PRICE (Automatic Drive)			
Hudson Jet	Joe Ricketts	22.0575	42.4606
LOW MEDIUM (Standard & Overdrive)			
Dodge V-8	Danny Eames	23.4189	52.8565
Mercury Monterey	Bill Stroppe	23.1554	52.5629
Studebaker Commander	Dick Griffith	24.5080	50.9767
Studebaker Land Cruiser	C. F. James	23.3962	49.7755
LOW MEDIUM (Automatic Drive)			
Studebaker Land Cruiser	Clarke Sanders	22.8885	49.3476
Hudson Super Wasp	Lee Hamer	19.0956	45.1229
Nash Statesman	Robert J. Steiner	19.4439	41.5321
UPPER MEDIUM (Standard & Overdrive)			
Nash Ambassador	Andy Henderson	22.5457	51.3140
De Soto Firedome V-8	Verne Holmquist	20.9209	50.9843
Kaiser Manhattan	Harry Greenwell	22.2707	49.0847
Packard Clipper	Les Butts	18.6737	45.2838
UPPER MEDIUM (Automatic Drive)			
Nash Ambassador Custom	Archie Bowen	21.1156	48.9037
Kaiser Dragon	T. J. Nicholson	21.4499	47.9835
Hudson Hornet	Hart Fullerton	18.9473	46.2409
HIGH PRICE (Automatic Drive)			
Lincoln Capri	Clay Smith	19.9416	52.3467
Chrysler Imperial	John Gerfen	17.2909	48.1553
Chrysler New Yorker	Jim Ickes	17.7479	45.7009
SPECIAL LIGHTWEIGHT CLASS			
Henry J Corsair 4	Woodward S. Bell	28.2587	48.5768
Nash Rambler Super	Pierce Venable	25.3748	45.2432
Average—All Cars		22.2869	48.6206

* Sweepstakes Winner.

** Got off course and ran out of gas.

15 miles times 2.1 tons gives him a ton mileage of 31.5. To beat him, you've got to get 19 miles to the gallon: 19 times 1.7 tons equals 32.3 ton miles.

Whether you beat Jim depends partly on what shape your cars are in, but more on how you drive.

"Driving the road ahead may be an oldie," says Tom Frost, this year's referee, "but it's important."

"Where possible," Frost adds, "plan your approach to traffic signals to avoid shifting or stopping. Drivers on the Economy Run stop-watched traffic lights in a score of towns and knew to the second their timing sequence. That saved better than a mile to the gallon in traffic."

"Shifting," says Art Pillsbury, chief steward for the AAA, "should be fairly precise. With manual gearshift, change from first to second as soon as you're rolling, into high by 10 miles an hour.

"Probably three-fifths of the cars now have automatic transmissions," he said. "You can't rush the shifting here. These transmissions shift naturally at certain speeds, say seven, 14 and 24 miles an hour. Just lift your foot slightly one mile

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an hour above each speed. Kicking the throttle down may cause down-shifting, which you need only in passing or hill climbing."

How you go up and down a hill can make an enormous difference.

"The proper way," you learn from Earl Cooper, steward, "varies with the kind of transmission. Generally, go just fast enough to clear the crown at 20 miles an hour, make up the wastage by barely cracking the throttle downhill. That's the mileage that costs little. One car in the Economy Run got only seven miles a gallon up one grade, but 95 miles a gallon down the other slope."

Drives Barefoot

"We hear funny things about drivers in the Run," Frank Verbeck, technical committeeman, told me. "Such as the man who sandpapered his foot and drove without shoes. You need no such stunt to keep the foot pedal steady. Just sit comfortably, with the seat adjusted for your length, and rest your foot easily on the throttle. Keep the linkage smooth and properly adjusted so you can make short throttle changes. Rest some weight on the heel to avoid pumping when you strike a bump."

"Sometimes it pays to pour on the coal," warns Frank Elliott, another technical expert. "If you have to drop down a gear on a mild hill, accelerate at full throttle in the lower gear, then shift up again. That uses less gas than climbing all the way at a slower speed. In cars with overdrive, some of the pros prefer second gear in overdrive instead of conventional third when things get a little too steep."

Those are tips from the experts. If your own results fall too far short of theirs, take the old bus in for a tune-up. It will save you money not only at the gas pump but in future repairs on a car that isn't running its best. END

WHAT'LL SHE TAKE? **Contest officials carefully measure gasoline capacity of Studebaker Land Cruiser. For an informal economy run, you can figure gas consumption by filling up at the start and keeping track of what you have to add to finish up with a full tank.**

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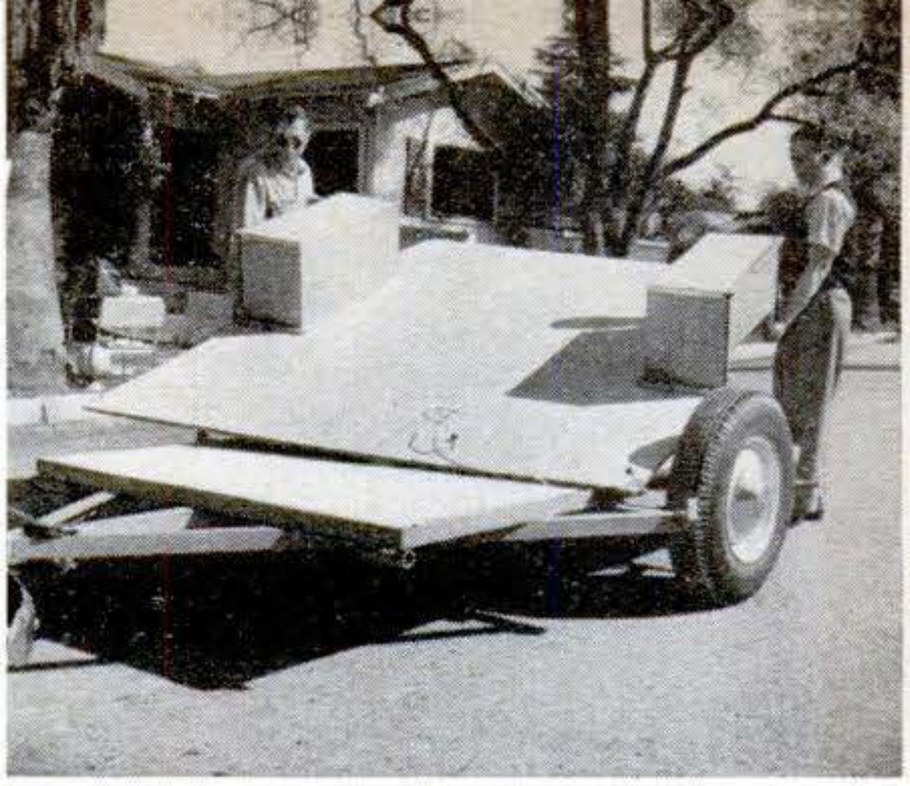
From Flatbed to Home Trailer in 30 Minutes



2 WIDE FLOOR for house-trailer, with wheel wells attached, is shoved into position above utility deck. Seven feet wide and 12 feet long, it is made of exterior plywood.

1 TRAILER-DOCTOR MALONE starts face-lifting operations which will convert his flatbed into a land cruiser. First the utility box sides are removed. The deck remains in place.

IF YOU own a utility trailer, you've probably played with the idea of a demountable top that would turn it into a cabin on wheels for vacation trips. Al Malone, a Los Angeles trailer-designer, has carried that idea a notch farther. His between-wheels, flatbed trailer becomes a full-width land cruiser in half an hour.

To provide the broadened base for his knockdown house trailer, Malone removes the sides of the utility box and mounts a special floor above the regular deck. To this he attaches five plywood wall sections, anchoring them with a roof which doubles as a storage case for the other parts. Into this room—more than six feet high, seven feet wide and 12 feet long—go a kitchen unit and a double bed. The stove and cabinet section usually is mounted before the sides are set up, but the bed can be eased into position just before the rear wall is attached. Complete, the outfit tips the beam at 1,300 pounds.

A convertible trailer model based on Malone's experimental design is now being sold by the J. H. Walker Co. Its several plywood sections are put together electronically, using high-powered dielectric heating to speed the curing of glued joints. The dual trailer combination, which costs $990, f.o.b. Los Angeles, draws attention wherever it is shown. But Malone has a word of warning for prospective buyers.

"Folks get curious," he says, "when a house disappears in its tracks or grows out of a flatbed in 30 minutes. Already I've had quite a lot of explaining to do to the hometown cops."

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3 ARCHED ROOF does double duty as a storage box for walls, which weigh about 80 pounds apiece. Malone starts body assembly with any one of five panels.

4 SIDE WALL gets part of its support from bolts along the base, the rest from connections with the wheel wells. A neoprene gasket along each edge insures watertight seals.

5 KITCHEN UNIT is hoisted aboard ahead of wheel wells, then jockeyed into position and bolted down. It includes a sink, butane stove, icebox and cupboard.

6 CABINETS reinforce curved front wall and right-hand side panel ahead of door. Remainder of side wall will follow. Only tools needed are a screwdriver and Allen wrench.

7 HEAVIEST SECTION is the 170-pound roof, which is angled against rear corners of the side walls and then slipped forward. Eccentric compression fixtures draw it down tight.

8 DOUBLE BED goes in through the rear. For easy handling, a special rack lifts it over the wheel wells. Now all that remains is to set up the rear wall with its built-in lights.

9 TIME'S UP, and so is the land cruiser. Most interested in Malone's trailer are sportsmen who want one kind of rig to get to camp, another to do on-the-spot hauling.

P.S.

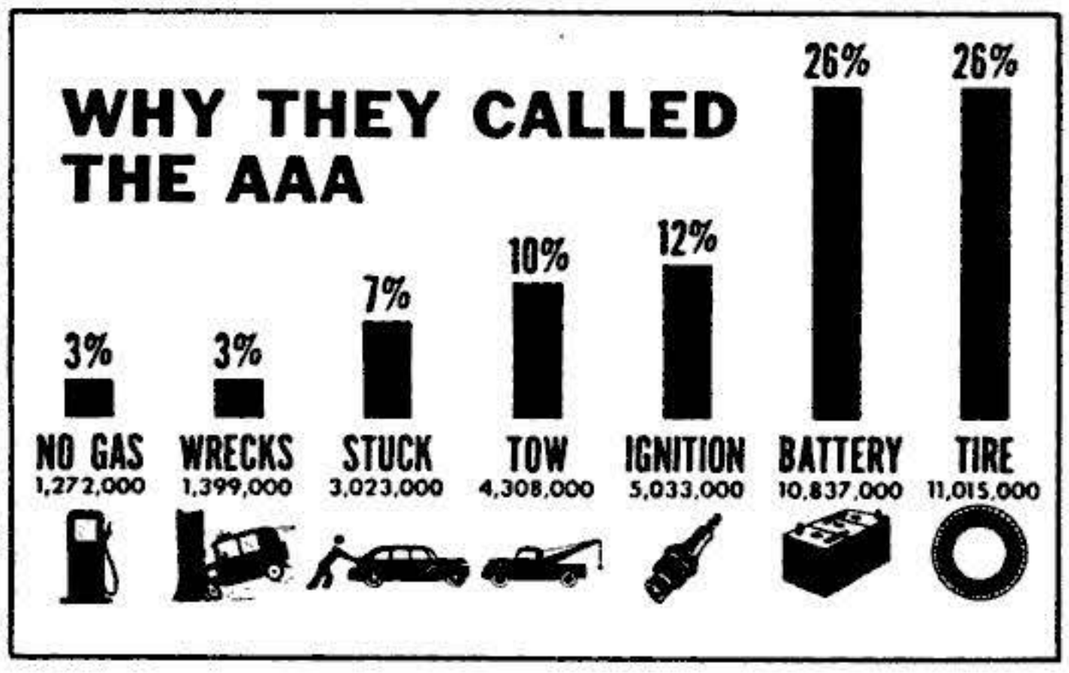
Last minute news & notes...

"PERHAPS THE MOST SENSATIONAL archaeological event of our time" is what Jordan's Director of Antiquities, G. L. Harding, calls the recent discovery of about seventy 2,000-year-old Biblical scrolls in a cave near Jerusalem. They include 19 books of the Old Testament. Arab shepherds unearthed them not far from another cave where a Bedouin found ancient scrolls in 1947 (PSM, Dec. '51, p. 98).

ARTIFICIAL LIGHTNING CRACKS WALNUTS for a growers' cooperative in Portland, Ore. A 65,000-volt, 5,000-ampere bolt shatters the shell but doesn't harm the meat.

ELECTRICITY STOPPED A RIVER from flooding excavations for a power plant at Essexville, Mich. Current was sent between 50 banks of positive and negative rods sunk into the ground. This stabilized the silty soil and prevented infiltration of river water. The system was invented by a German, Dr. Lee Casagrande, now at Harvard, and was first used during construction of U-boat pens in World War II.

IF YOU RAN OUT OF GAS last year, you had plenty of company. The AAA says 1,272,000 of its trouble calls last year were for that reason alone. But tires and batteries caused most breakdowns (see chart).



ROUTINE LIE-DETECTOR TESTS at the Oak Ridge atom plant have been stopped. The AEC says the cost in money and employee relations outweighs any advantages, finds no proof that the instrument can catch spies. The lie detector will still be used in special cases, however.

SYNTHETIC OIL has made it possible to put jet engines of unprecedented power in our latest warplanes. Already in use, the Standard Oil development lubricates engine bearings and gears at temperatures above 450°, which would quickly boil away conventional oil under high altitudes' reduced atmospheric pressure . . . Tubeless tires, like those sold for cars, are now in use on jet planes and heavy trucks . . . RAF student pilots may start on jets right from the beginning. Reason: jet flying is so different that trainees waste much time unlearning piston-engine techniques.

SOAP BOX DERBY RACERS will compete Aug. 9 in Akron for the highest stakes in the 16 years the contest has been held. Top prizes include $15,000 in college scholarships.

BRITISH ATOMIC ARSENAL includes four different weapons, according to a London newspaper. They are a rocket warhead, torpedo, artillery shell and guided bomb . . . High-school science students may soon be using radioactive atomic materials in lab experiments--one supply firm plans to market special samples of limited, harmless radioactivity . . . Human cancers can now be kept alive in rats, an achievement expected to speed tests of new cancer treatments.

ENGINEERS NOW FIGHT CORROSION on ship bottoms the same way they do it in home hot-water tanks--with magnesium. Three tons of the light metal bolted to the bottom of a tanker are reported to have kept her 80 percent corrosion-free . . . Transistor car radios are foreseen by GE engineers, who point out that they would work directly off auto batteries, eliminating need for the vibrators now used.

The Editors

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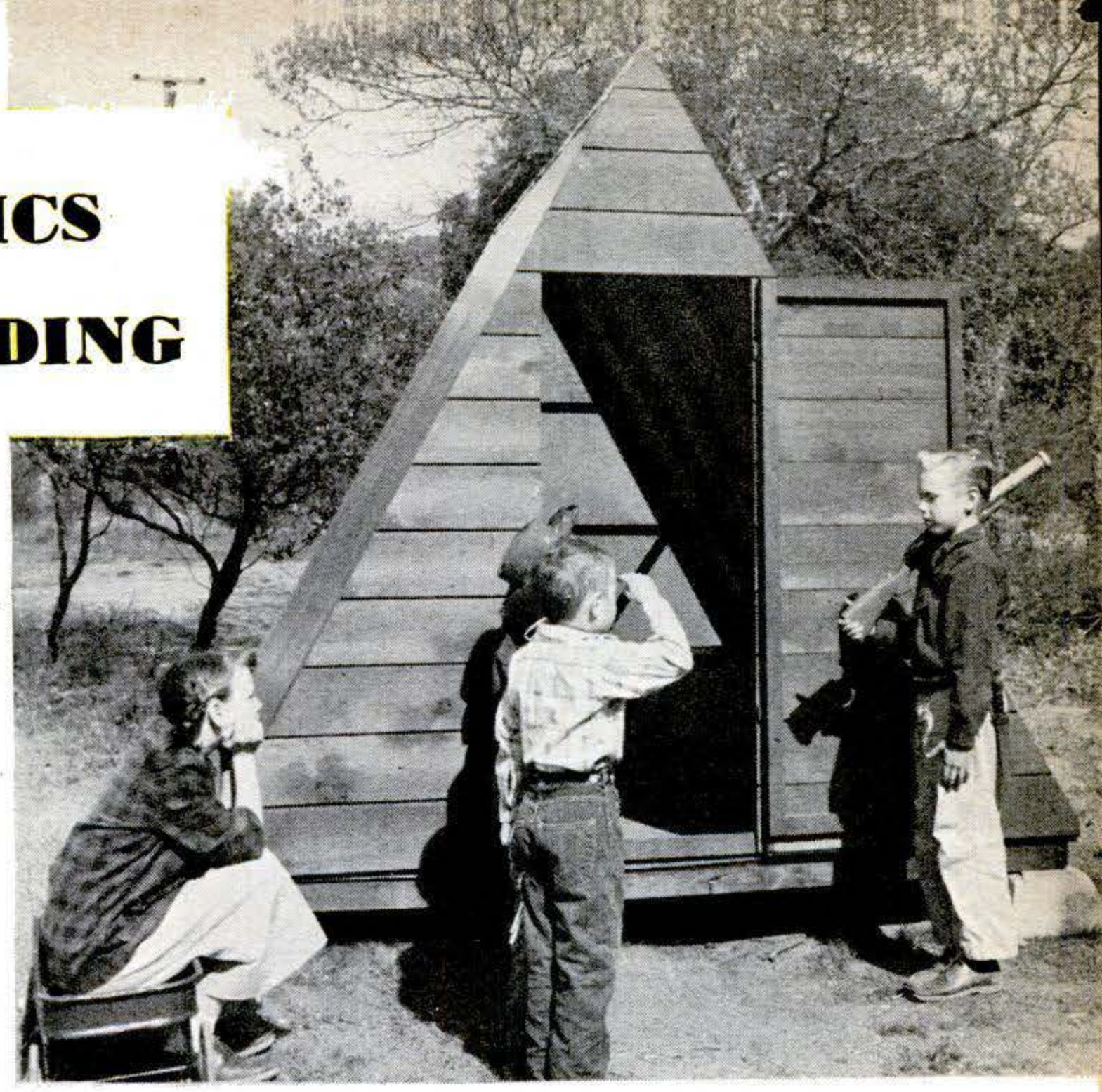
MECHANICS *and* HOMEBUILDING

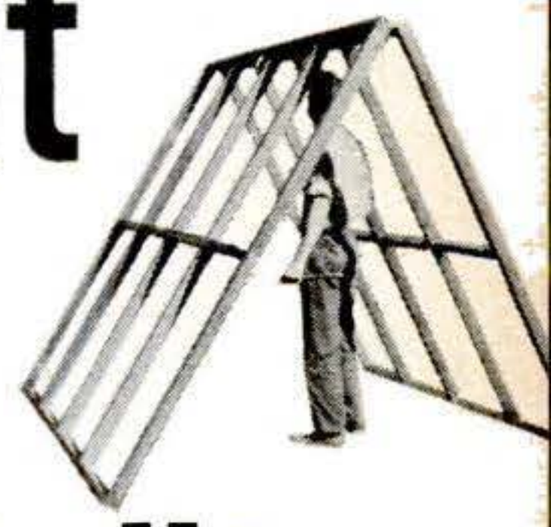
You can put up this wood "pup tent" in a couple of days' easy work. It won't cost a fortune, either.



IT'S A PLAYHOUSE. Small fry of the neighborhood will have a high old time playing their games with this handsome hut as headquarters.

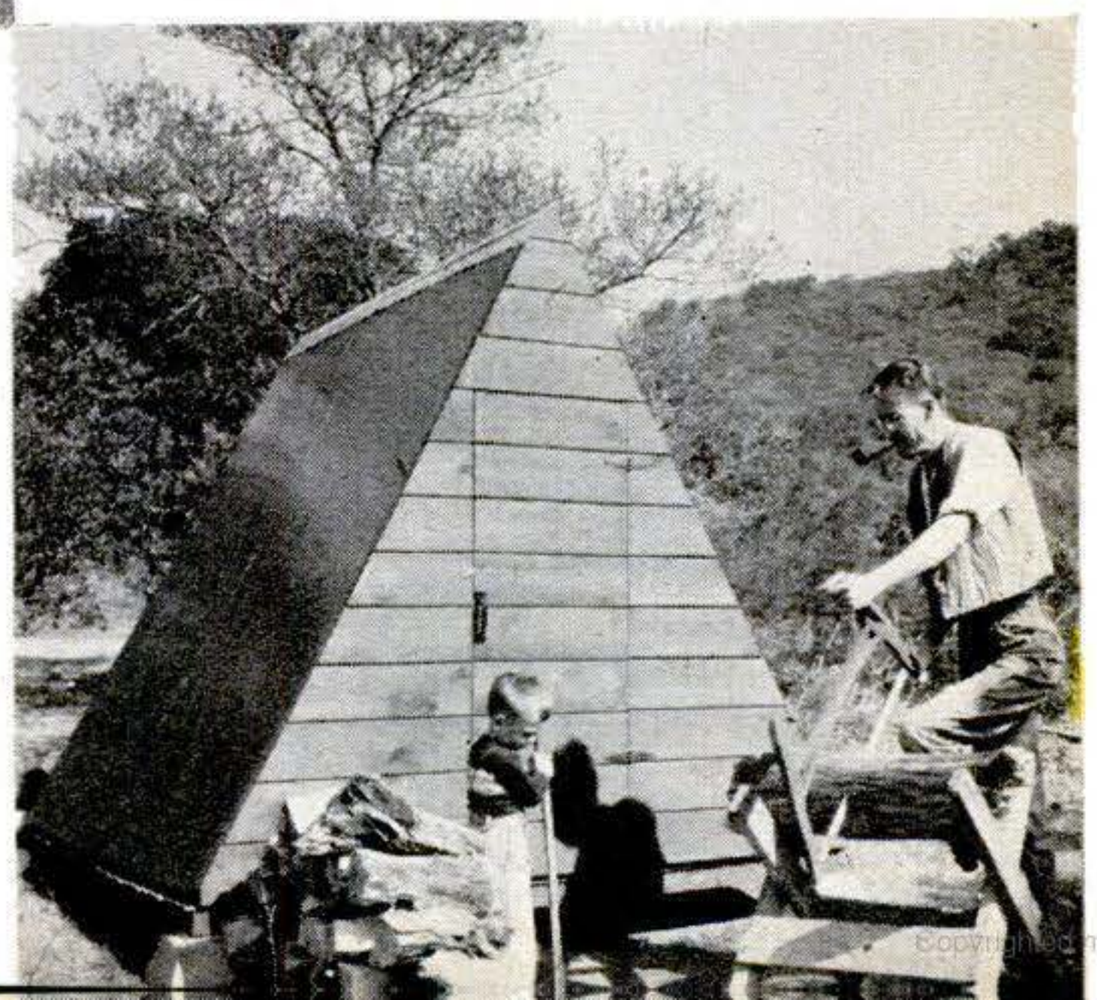
You'll find dozens of uses for

The Hut That Jerry Built



IT'S A STORAGE SHED. In most homes, there's never quite enough space for bicycles, coaster wagons, yard furniture and such things.

IT'S A WOODSHED. After firewood is cut, don't leave it outdoors to soak up water. There'll be room in the hut for your garden tools, too.



Please turn page for how to build it.

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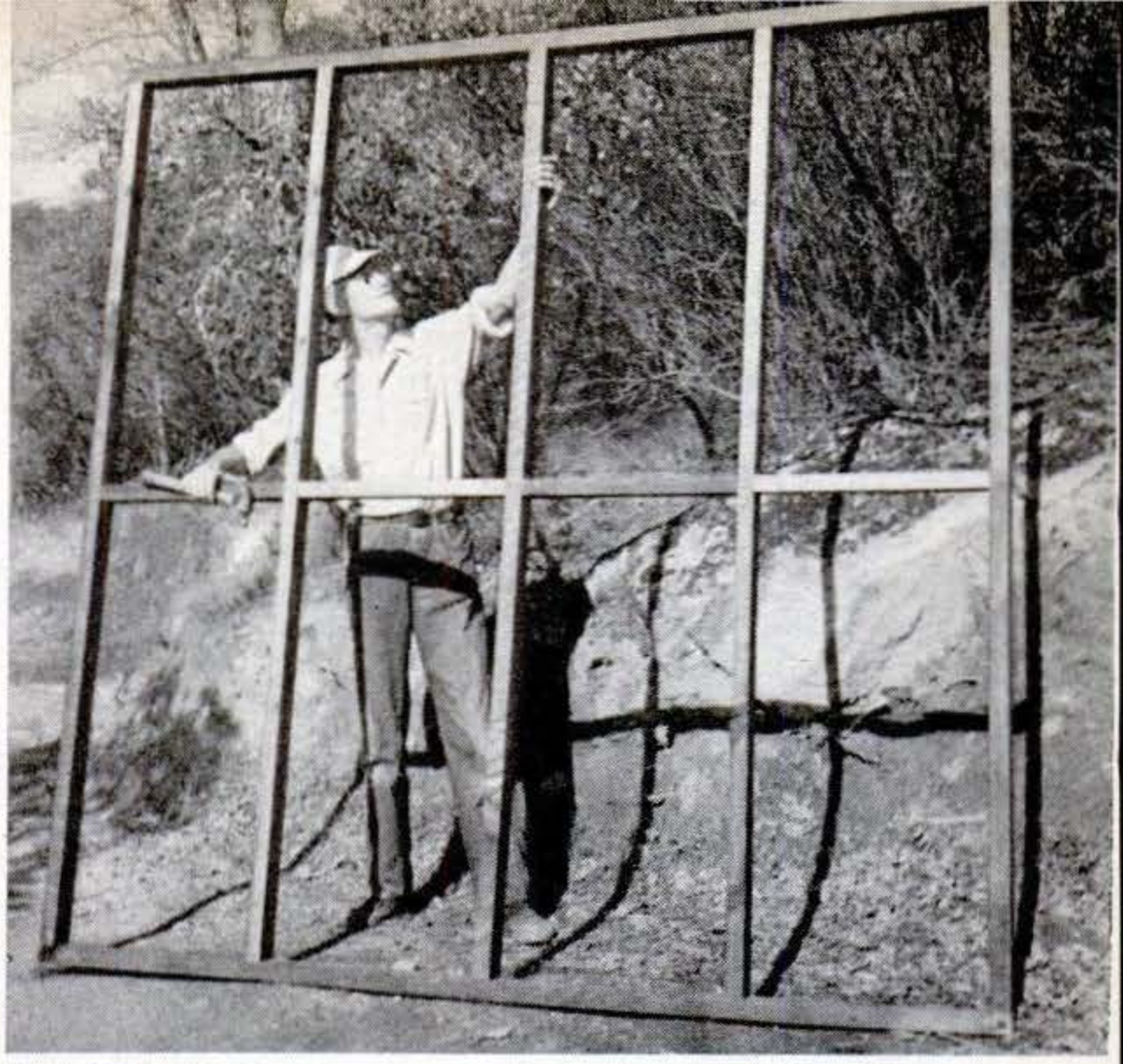
How I Built The Hut

By Jerry Parker

Playhouse, woodshed, bike garage or tool house—what do you need? This portable "tent" fills the bill.



1 THREE FRAMES were used, each one 8′ by 8′. These were made of two-by-threes placed on 24″ centers with middle bracing.

WE WERE talking about building projects one evening and Philip said, "I want a playhouse." Philip is four.

"And while you're at it," my wife chimed in, "we need a place to store summer furniture and to put the children's bikes."

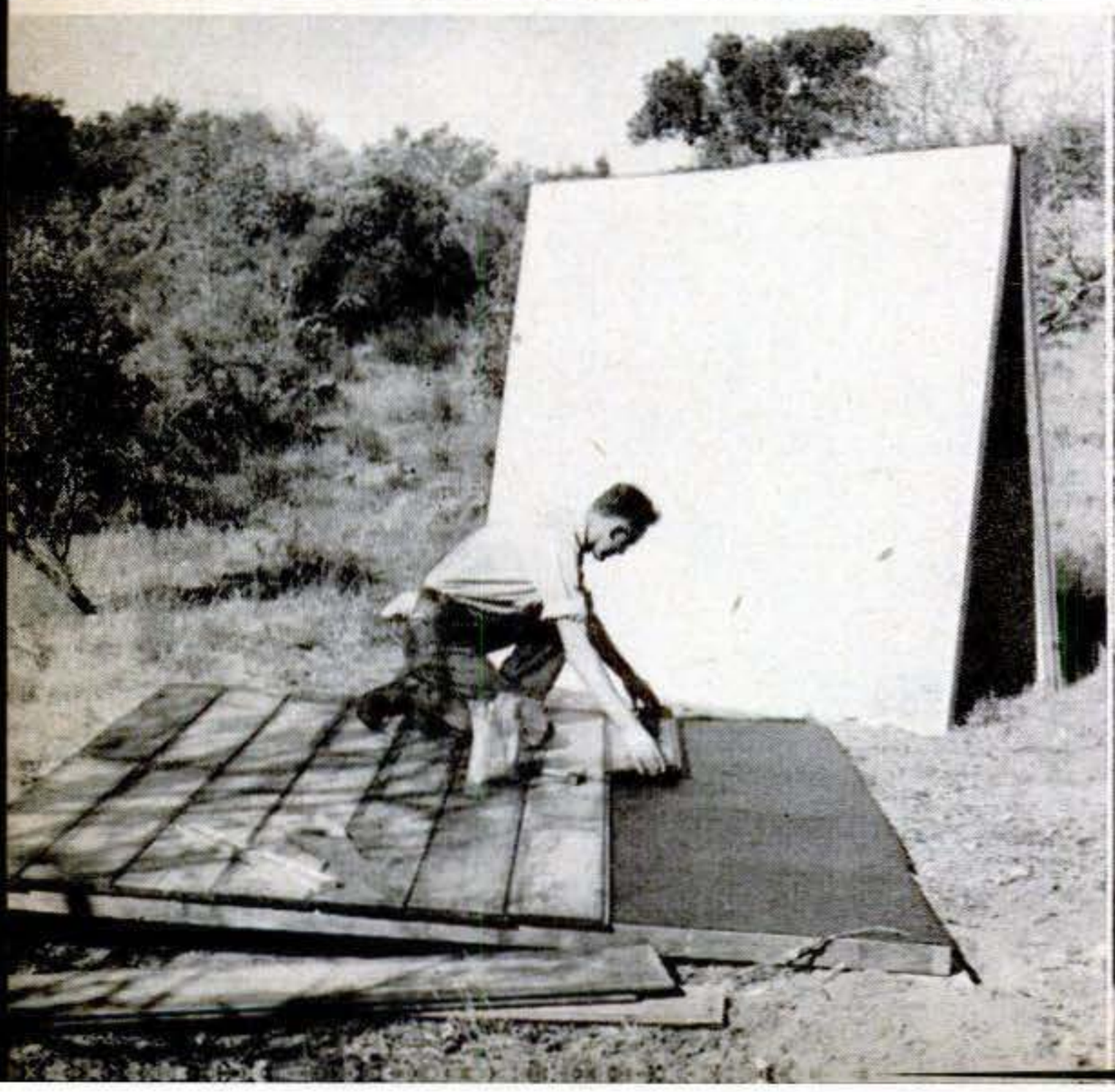
"We also need a woodshed," I murmured.

My wife thought a moment. "Well," she said, "you ought to design a little building to meet *all* those needs. Make it so it can be moved too—if we want to."

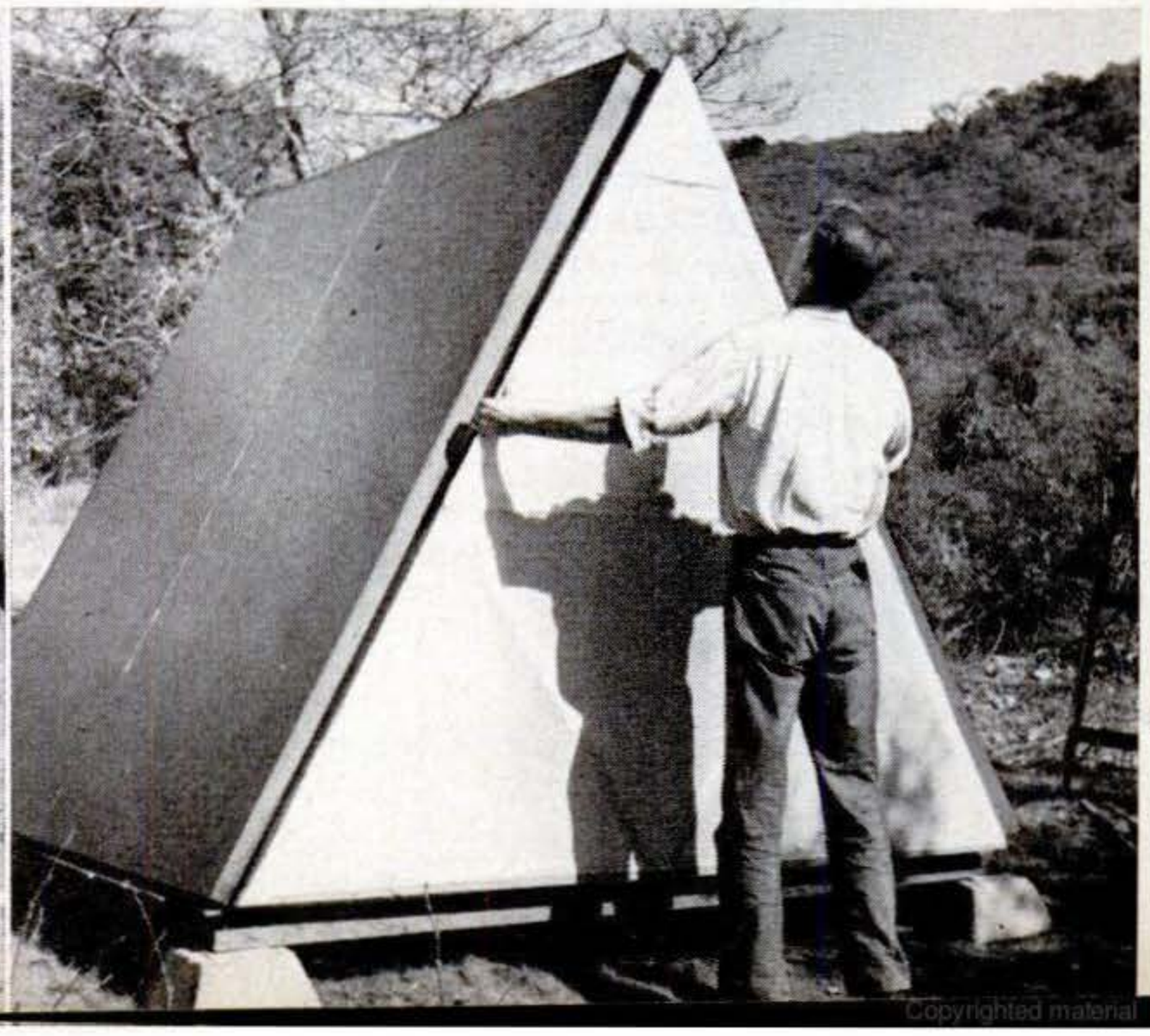
"Wow!" I replied. "Who do you think I am? Frank Lloyd Wright?"

My wife gave me a long glance. "No. Not quite. But haven't you learned anything from POPULAR SCIENCE?"

4 FLOOR is third 8′ by 8′ frame leveled on four concrete piers. Rustic siding was put down over building paper as the flooring.



5 GLASS SUBSTITUTE, often used on farms, was stapled to frame of one-by-twos for one end. You might also use a vinyl sheeting.



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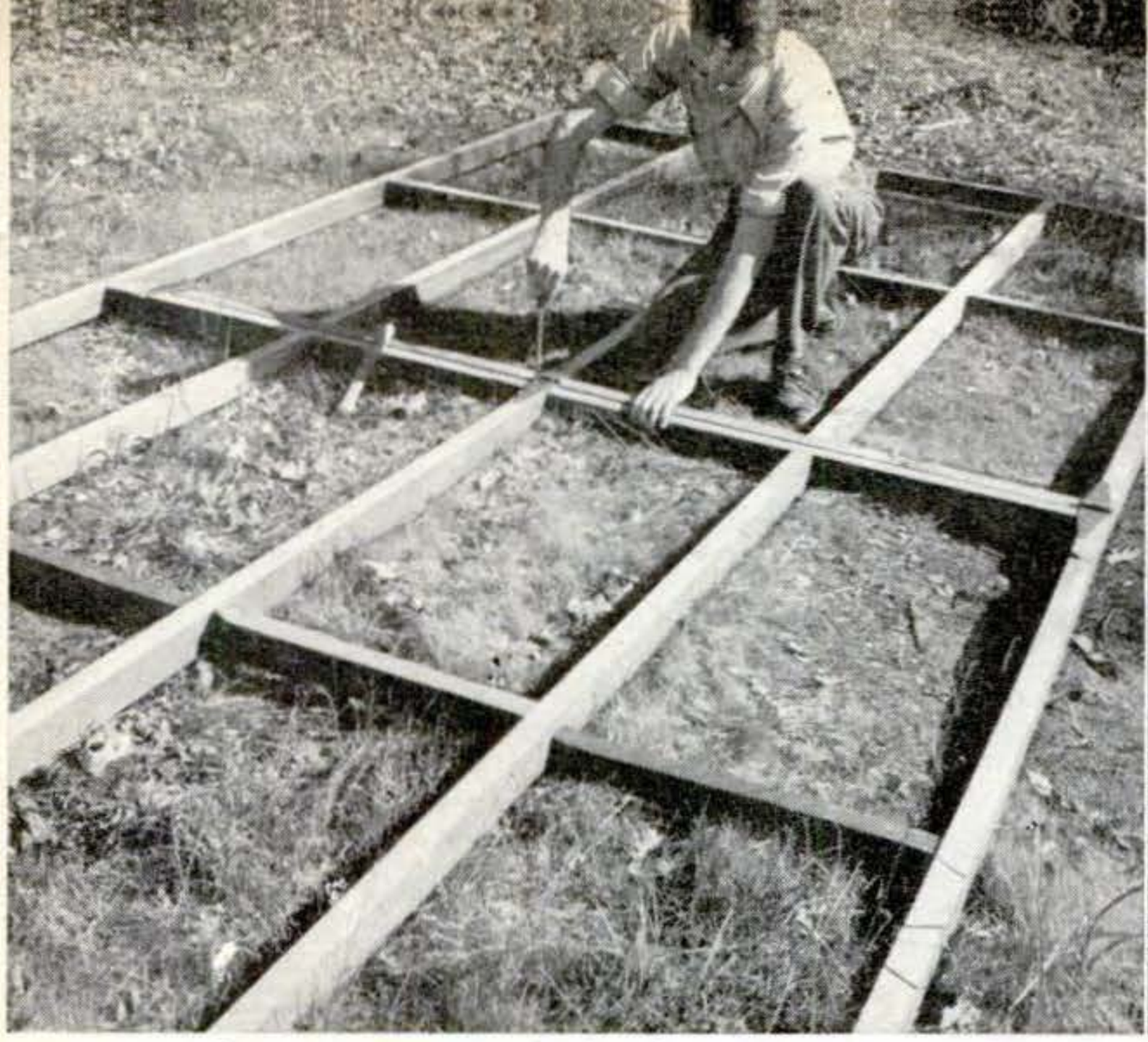
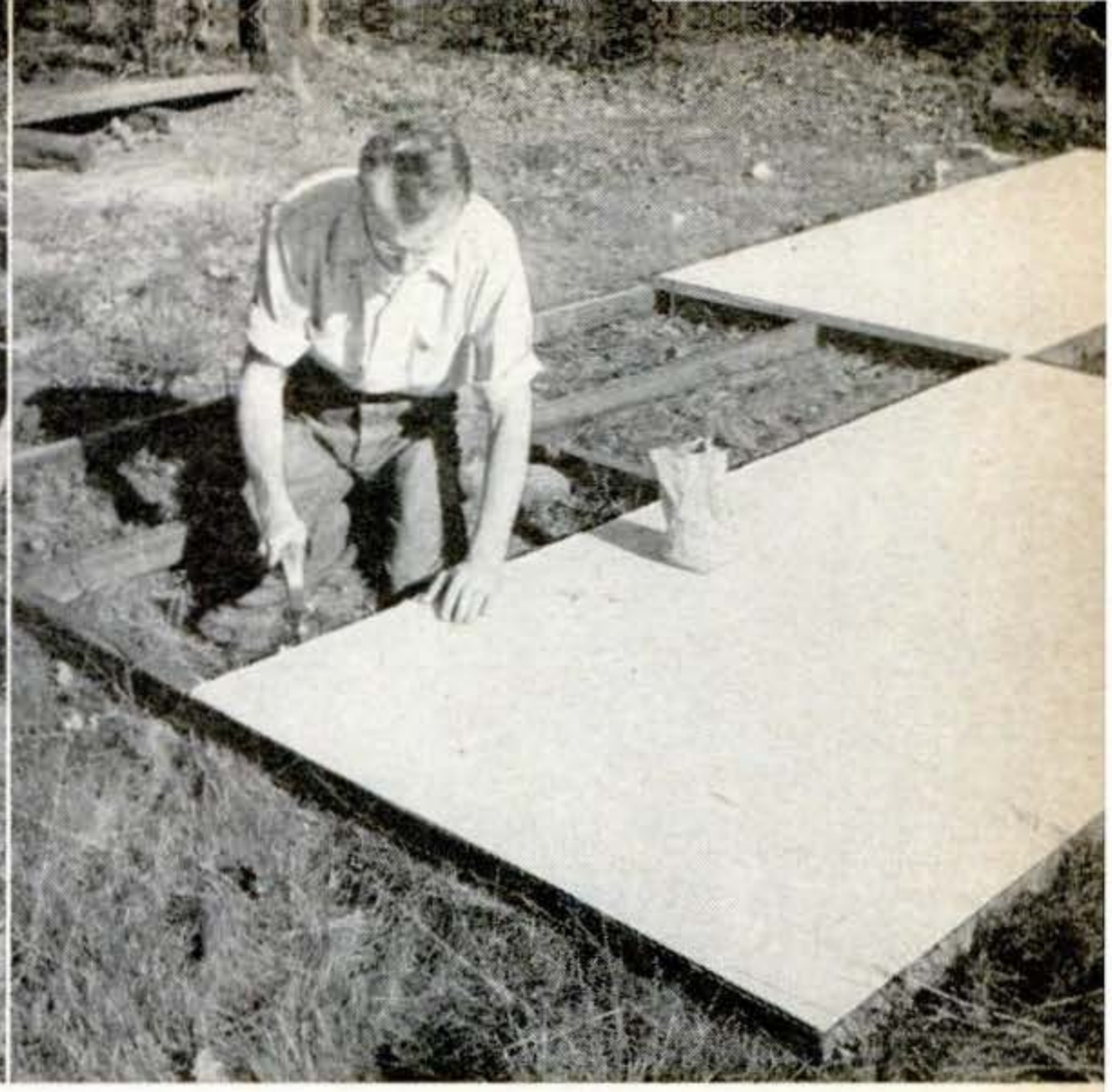


2 TWO SIDES of the hut were fastened together at the ridge with 6″ strap hinges. The hinges go on inside of A-shaped frame.



3 COVERING consists of ⅛″ 4′ by 8′ asbestos-cement panels attached with 1½″ galvanized nails. Calk joints where sheets butt.

So I started doodling rough sketches of outbuildings. They looked awful.

"Should be portable, eh?" In times of stress I am apt to talk to myself. "Well, tents are the most portable shelters I know."

Something like a little electric-light bulb flashed in my brain.

"Eureka!" I shouted. "How about a building shaped like a tent, like a big pup tent maybe, that would be hinged at the top with big strap hinges and sit on a platform placed on concrete piers? Then if I wanted to I could just fold the whole thing up and take it away—like an Arab."

"Yeah," said a doubting little voice inside me. "You and three piano movers maybe!"

I used redwood two-by-threes for the frame and made the floor and one end from redwood rustic siding. The flooring is random width (and random length, as well). I got it at a bargain price by shopping lumberyards. I spent a little over $40 for the complete job.

My family liked the building and it *was* portable, just as I'd planned. We christened it "The Hut."

"There's just one thing, dear," said my wife. She put a finger on one cheek and I knew what was coming. "It's much too nice a building to keep wood in."

It is, too.

So I'll have to build another. END

6 OTHER END was made by nailing rustic siding to one-by-two frame. Then this end was screwed to the edges of sloping sides.

7 RIDGE CAP is two 5′ lengths of aluminum overlapped and nailed in place. I painted the asbestos panels with red enamel.

Record Caddy Totes Phonograph

The young music lover's mother will like this cart, too, for it makes cleanup easier.

THIS record caddy not only follows your youngster wherever she goes, but it makes it a lot easier for mom to pick up after her, too. The wheeled cart rolls easily from room to room and holds a small phonograph and enough records to provide any young music lover with hours of happy listening. When cleanup time comes, it's an easy job to slip the records back on the shelves, coil up the cord on the cleat at the rear and wheel the cart back to the bedroom or out of the way in a closet or alcove.

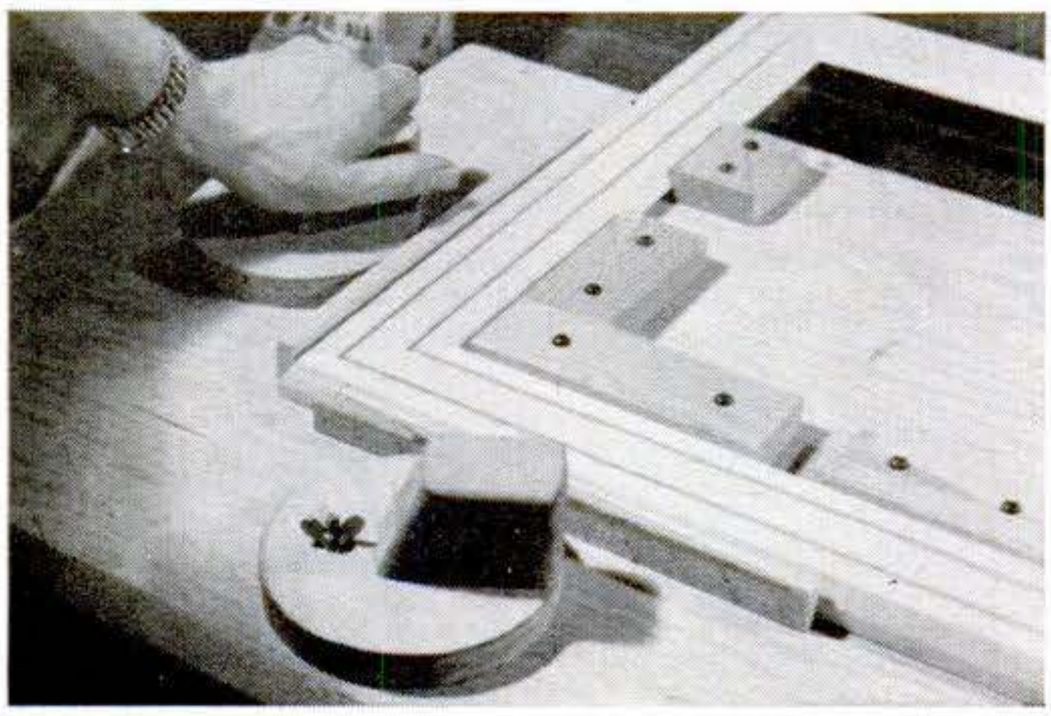
RECORD CADDY keeps phonograph out from under little feet as well as big ones, stores records neatly where they won't get lost or broken.

The 7½″ shelves I made are just right for the 45-r.p.m. and small 78-r.p.m. children's records. For 10″ records, make the shelves 11″ high and deep.

Sides and shelves. These are made from either ¾″ plywood or pine. Cut out the sides first, sloping the fronts and rounding the tops as shown. Run a ¼″ rabbet along the inside rear edge of each piece to take the back.

The shelves have a 45° bevel at the front and are fastened to the sidepieces with glue and countersunk wood screws. Rabbet the underside of the lower shelf to take the 2⅜″-high base facing that runs across the front. The base, in turn, is beveled to fit the slope of the shelf. Use glue and finishing nails to get a tight joint between the shelf and the base.

Assembling the backs. Both the inner and outer backpieces are



Cams Keep Glue Job Square

HERE is what I believe is just about the simplest way of gluing picture frames and small boxes and having them come out square. The two cams not only keep the frame square against the blocks but they exert pressure into the joint, thereby assuring a good glue job.

The wing nuts are turned down tight after the cams have been swung against the pieces of scrap wood that prevent marks on the frame.—*Ivan F. Vap, St. Paul, Minn.*

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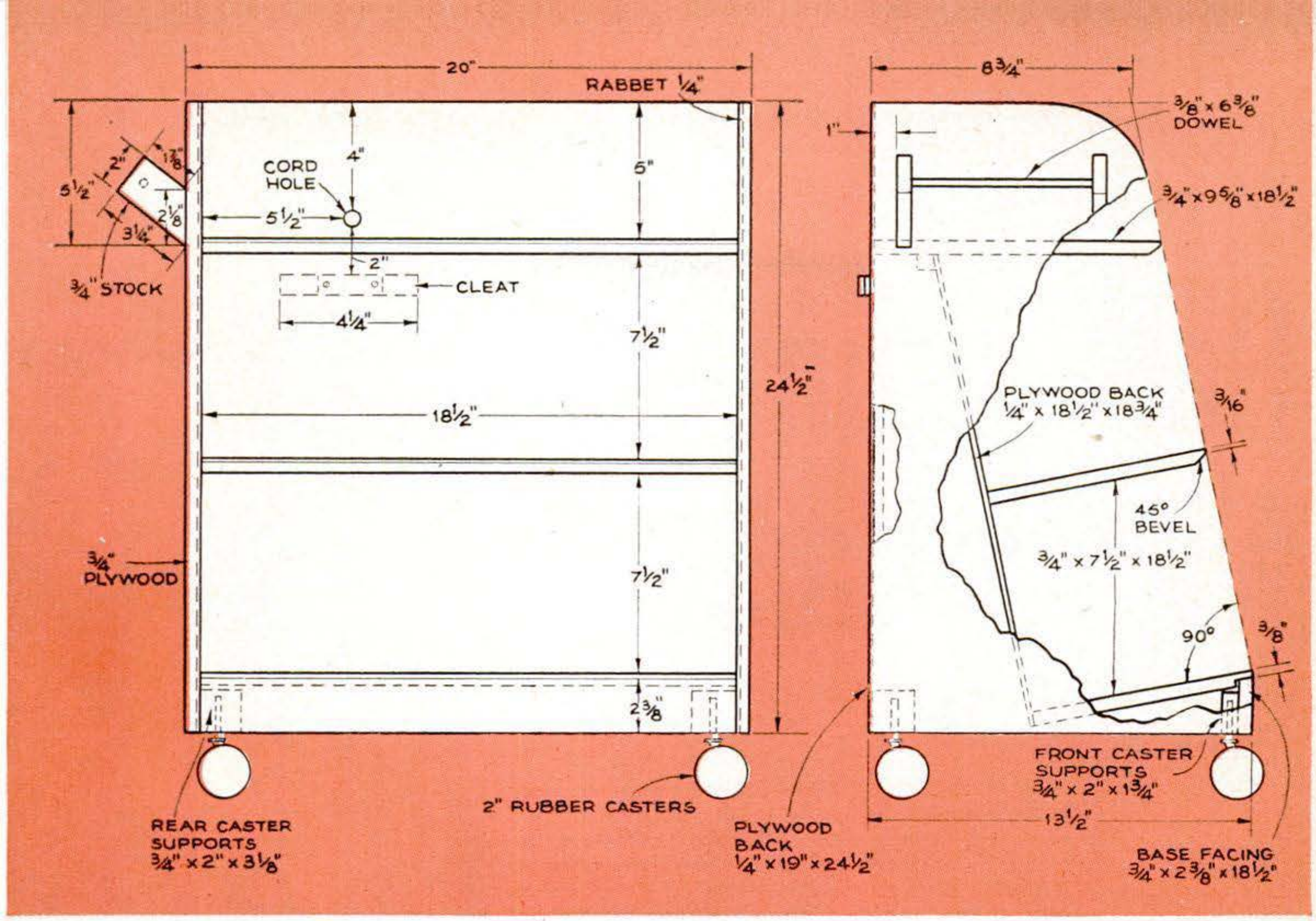


1/4" plywood. Put the inner one on first, fitting it snugly between the sides and nailing it to the rear edges of the shelves and to the cleat under the top shelf.

Before putting on the outer back, bore a 1" hole in it just above the top shelf for the player cord, and fasten on the wood cleat for winding up the cord when it's not in use. The back is then glued and nailed into the rabbeted edges of the sides.

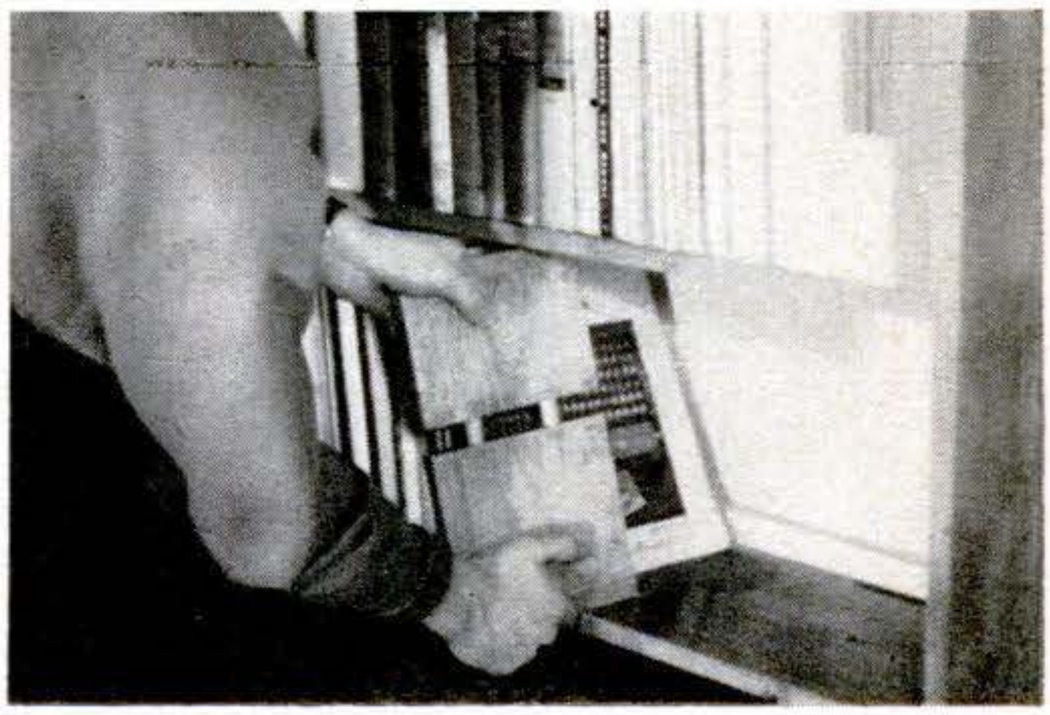
Casters make wheels. Four 2" rubber-wheel casters are supported by 3/4" wood blocks fastened to the inside corners. The back two are 3 1/8" high and are screwed to the sidepieces: the front two are 1 3/4" high and are screwed to the base facing.

CASTERS ARE SUPPORTED by blocks screwed to inside corners of cart. Caster holes are drilled half into blocks, half into cart body.

The cart's handle is made from 3/4" by 2" stock and a 3/8" dowel. I finished the cart with enamel, after first sanding it down and applying sealer. You add decorations by putting on decals or cutting your own designs in cardboard stencils and painting them on.—*Sylvester J. Zuk, Chicago.*

Springs Retain Shelf Divider

UNFILLED bookshelves can be kept neater with this movable divider. It consists of two pieces of 3/4" pine having a total height 2" less than the distance between the shelves. Coil springs are located in holes in one part and dowels glued in the other serve as guide rods. You put the divider between the shelves by compressing the springs. Strips of sponge rubber on the top and bottom edges keep the divider from slipping.—*I. R. Sauvageau, Niagara Falls, N. Y.*



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Lots of duffers can bag a bear with a rifle, but it takes woodcraft to look one in the eye with a lens.

How I Hunt with a Camera

By Shep Shepherd

WRITER SETS UP CAMERA in the reeds to shoot sitting ducks from the safety of a blind several feet away, after placing decoys on the water in background. Note bar across top of tripod. This makes it possible for him to mount two cameras on the single tripod and operate both by remote-control cords.

A BLACK BEAR was shot from the safety of other rocks across the ravine. Regular lens in single-lens reflex made distant view at left, a telephoto lens gave the close-up below.

As hunters become more plentiful, game is becoming scarcer. So it is little wonder that more and more hunters are taking to the fields with cameras instead of guns. This way you can take game, yet leave it for the next fellow too.

In my book, there is no bigger thrill than capturing a good sharp picture of wild game in its natural habitat. Consider the case of Skip Reed, myself and the mountain lion.

We had tracked the lion several hours with Skip's dogs. Finally, we got into some high brush where the horses couldn't go. Our cat was in there somewhere. We knew it would be only a matter of minutes until the dogs brought him to bay. We tied the horses to saplings and waited for the signal from the dogs. When it came, we went in;

Skip with his .30-06, me with my twin-lens reflex.

The cat came to bay on the ground (unusual for a cougar). Skip kept the brute in

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his sights while I worked up to within 20 feet and got my first picture. The sound of my shutter alarmed the cat and caused him to take off for a half-dead tree. He made it —with the dogs snapping at his heels. There he sat, snarling his hatred. Again Skip lined him up in the sights while I came up underneath for two more shots.

That was two years ago. Today the lion's skin hangs on Skip's wall. Three wonderful pictures of the lion, full of ferocious life, hang on mine.

Picture Hunter Must Be Patient

Some wildlife pictures are the result of luck. But the best ones are a reward for patience and woodcraft. It requires a far greater amount of these attributes to bring back good pictures of the game than to bring back the game itself.

There are several ways to go about photographing wild game. The easiest and surest is to carry a camera equipped with a good telephoto lens. The most thrilling and most deeply satisfying way, however, is to stalk the game and photograph it with an ordinary lens. This not only adds to the thrill. It does away with the necessity for expensive telephoto lenses.

Of course there are times when it is best to use a telephoto lens; when you don't dare go nearer the subject. I had that happen once in Siskiyou County, California. I caught sight of a big black bear as I climbed a rise on the way back to where I'd left my car. The bear was nosing around some large boulders looking for food. I worked my way up to within 40 yards, coming upwind. There was enough cover to bring me closer—much closer—without attracting

the bear's attention—*maybe*. It was the "maybe" that stopped me. I was not armed. I knew that bears never attack without provocation. But I had no idea what a bear

Writer photographed mountain lion up a tree while companion kept a gun on animal.

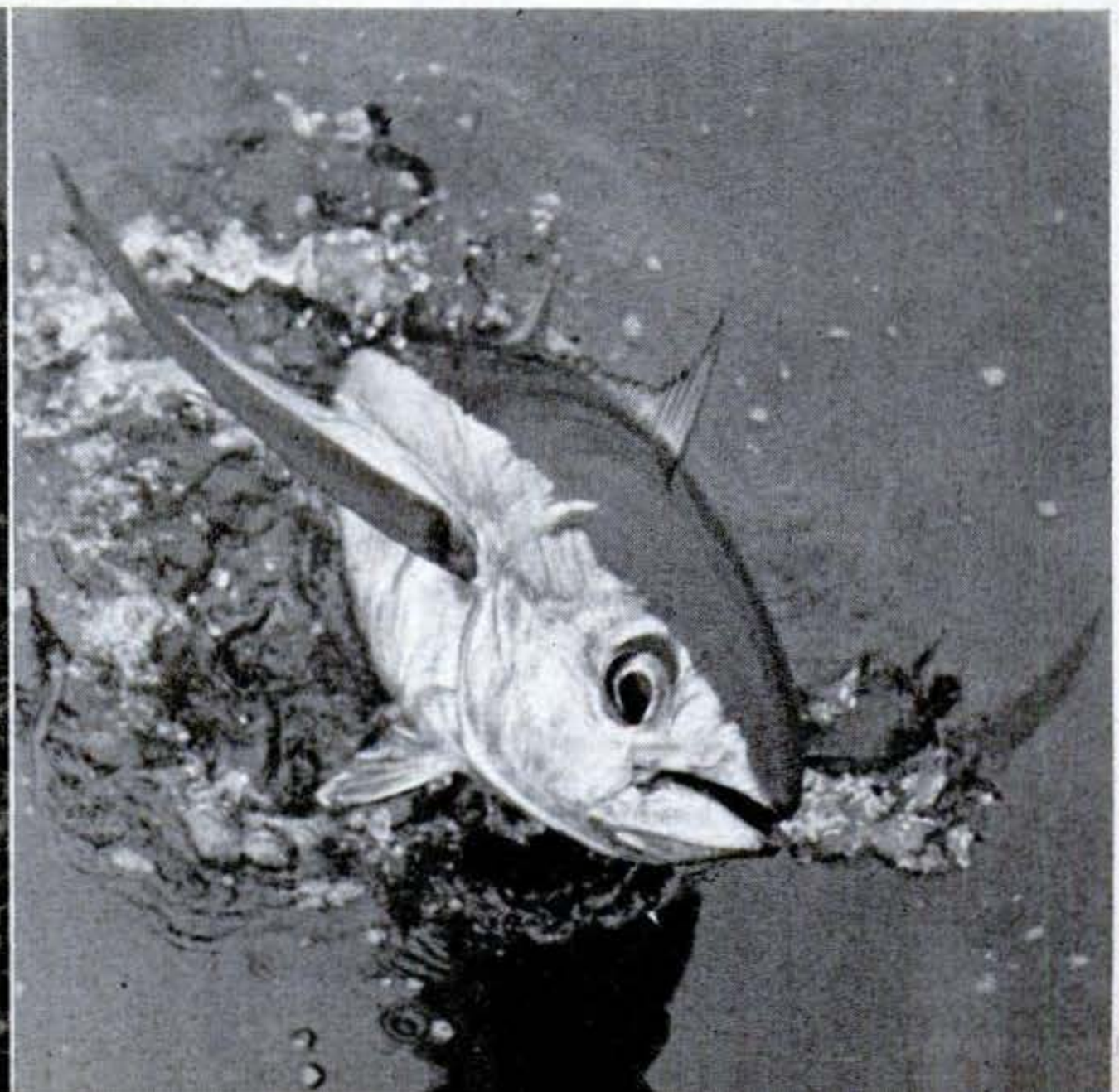
A PACK TRIP through mountain scenery as beautiful as this will give your camera a good workout. A light-yellow filter slipped over the lens will bring out any clouds in the sky.

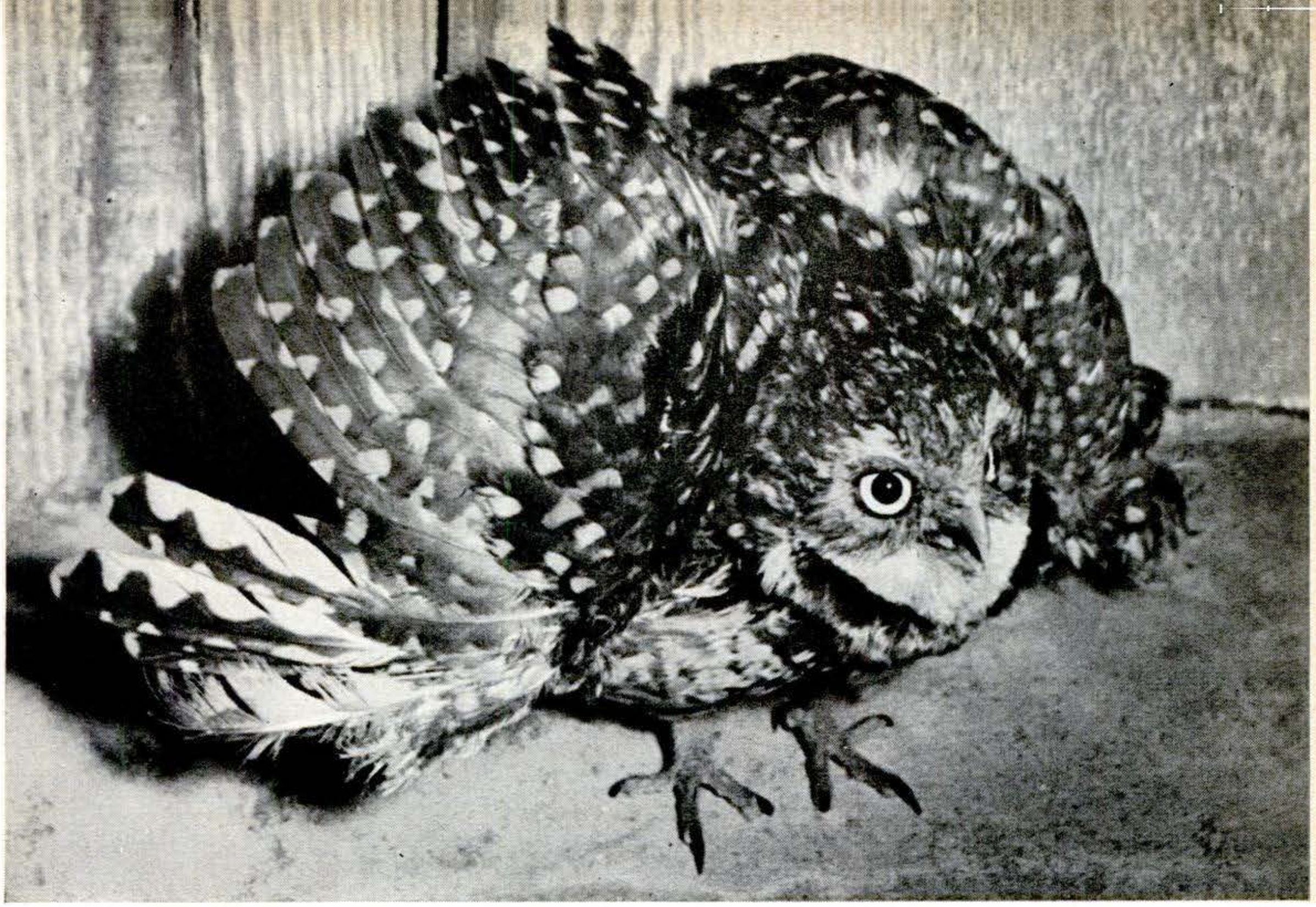
might consider to be provocation. I made a few pictures with the normal lens. Then I inserted a telephoto and made close-ups. In this case I was using a single-lens reflex which would quickly accept lenses of different focal lengths.

The camera you hunt with should have a top shutter speed of at least 1/200 second, preferably 1/400 or 1/500, and a lens opening of no less than f/4.5. Compactness is a major factor, too. The smaller cameras have these advantages but have the draw-

SNOW OWL. If you can spot this fellow while he is busy feeding, he is rather easy to stalk for close-up shots. A semi-telephoto lens got this picture from about 25 feet away.

YOU CAN HUNT AT SEA, TOO. This picture of a leaping albacore was made with a 35-mm. camera at 1/1,000 second. Fishing with a camera can be as much fun as using a hook.

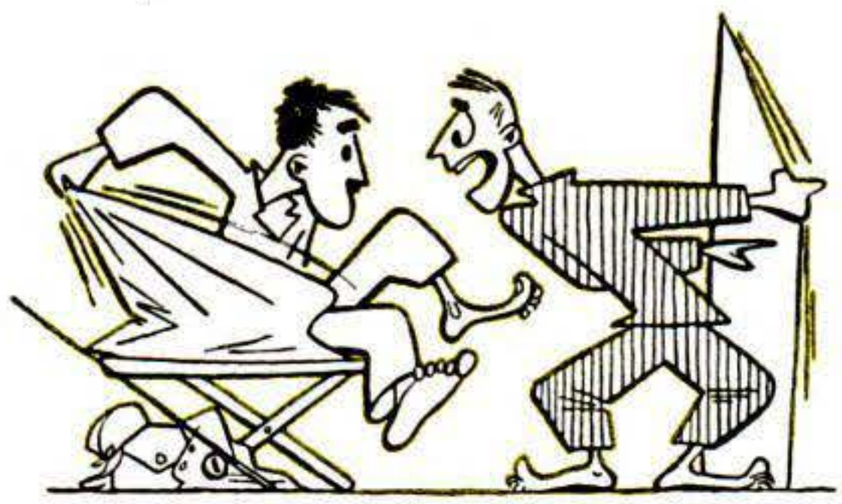




LITTLE TOUGHIE! This angry-looking burrowing owl seems willing to spot you a couple of hundred pounds and still take you on. The writer found the bird in an old barn.

back of small negative size. The big press-type cameras are too bulky and cumbersome for most hunting-and-fishing territories. Roll-film cameras giving a negative size of 2¼″ by 2¼″ or 2¼″ by 3¼″ are a good compromise.

Not too many cameras of this size can be fitted with a telephoto lens. However there are supplementary slip-on lenses that will increase the power of the normal lens as much as four times. Also equip the camera with a good slip-on sunshade. This is important. Without it you must always shoot with the sun somewhere behind you and the game may not always be obliging enough to get in the proper position. With an efficient sunshade you can shoot almost directly into the sun without ruining the negative with lens flare.



I once had an experience with another bear that taught me one paramount rule of game hunting with a camera: always be ready to shoot quickly.

Two of us had gone up to the high Sierras for opening of the California trout season in early May. At that altitude, 7,500 feet, snow still covered the ground. Early one morning we heard a noise outside. Eddie pushed open the flaps of the tent and immediately yelled "bear!" I threw the blankets aside and grabbed for my camera at the foot of my bed. On top of my camera case I had piled clothes, plus tackle box and gear. Hurriedly I tossed the stuff aside, got the camera out of its case, removed a used holder and slammed in a fresh one. In the meantime Eddie had gotten his camera out of a coat pocket and was standing by the open flap, anxiously peering at the little red window in the camera back and hastily turning the knob to advance the film to the next number.

By the time we were ready to shoot, the bear was disappearing into the timber at a fast lope. All we had left were his tracks in the snow. By those we could see where he had stopped and stood upright, apparently when Eddie yelled. What a picture

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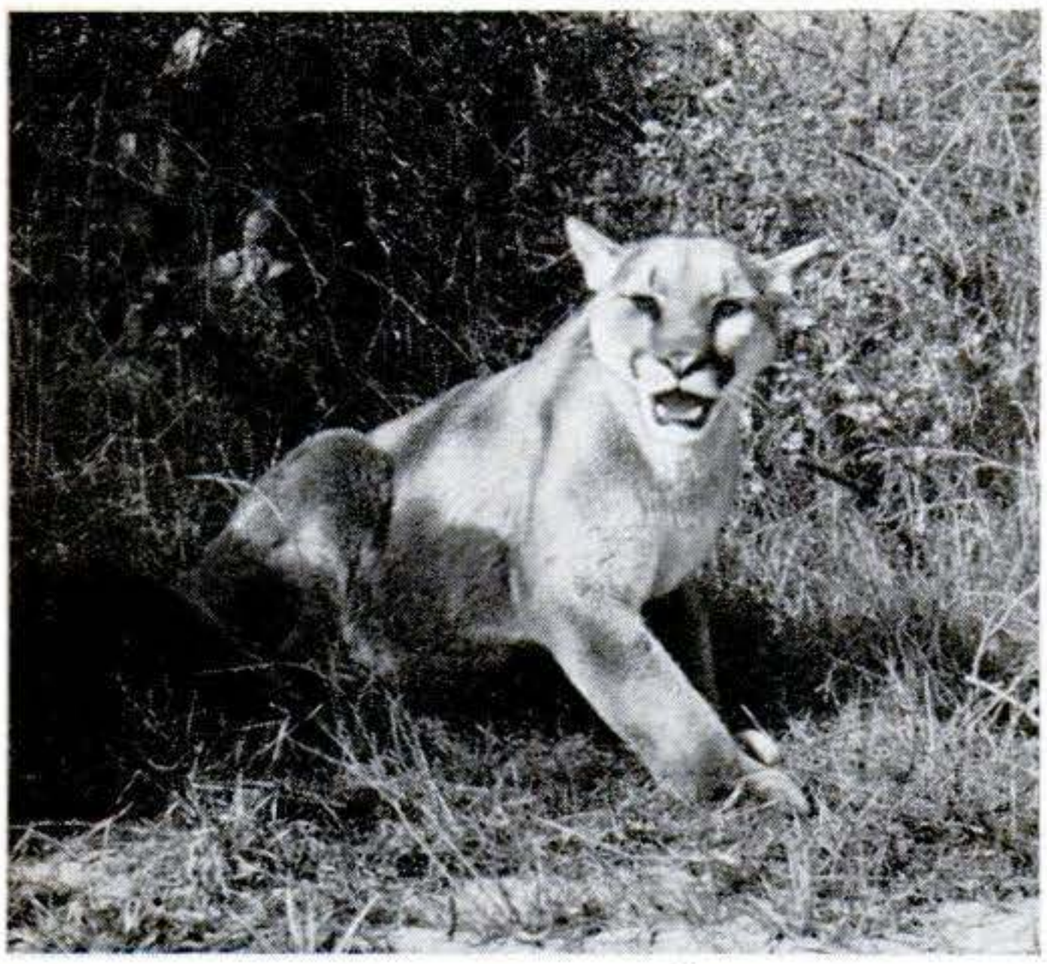
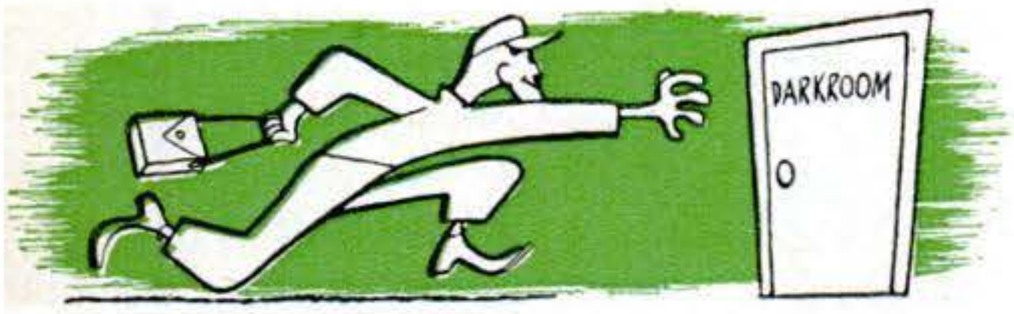


NEVER GET THIS CLOSE to a loose mountain lion unless you are backed up by a good man with a hunting rifle. These cats are big and rough. Telephoto lens was used here.

that would have been—the bear standing there upright as if posing!

Your camera should have synchronized flash attached. Most game is nocturnal, moving freely at night. That's the time to do some thrilling camera hunting and that's when flash is indispensable. You will have to locate a game trail, a den or a watering place, then take a position downwind and wait. This gets tiresome but it pays off in excellent pictures. Pre-focus the camera at one spot and wait for the subject to get in place. Don't worry about the night being dark. You'll be surprised how well you can see after your eyes become accustomed to the darkness.

I like the thrill of stalking game and I think you will too. But you also can get pictures while you are asleep in bed if you prefer it that way. In one way it's even



more thrilling because you never know what you've photographed until the film is processed. You do it by setting a camera trap for game that happens along.

First locate the best spot, most likely a game trail. Lash the camera securely to a tree, aim it at a given spot and cock the shutter. Run a stout string from the camera shutter release down to 2″ or 3″ above the ground and across the trail where the camera is focused. Pass the string around saplings or drive small stakes if necessary to lead the string where you want it. Put a flash bulb in the gun and everything is ready. When an animal hits the string he takes his own picture.

How to Bait a Camera Trap

You can use bait with camera traps too. Attach the string to the bait so the shutter will be tripped no matter how the game approaches the bait. Protect the camera as well as possible against weather. Usually a piece of cardboard or heavy paper tied to the tree just above the camera and projecting over it is all that is needed. Next morning you find the flash bulb fired and the shutter snapped. Imagine the excitement and anticipation until you see the finished negative!

You'll get to know your game animals better through camera hunting. You'll learn woodcraft too and increase your enjoyment of the outdoors a hundredfold.

So get a camera and go hunting. You will be amazed at how much downright pleasure you've been missing. END

MOUSETRAP FLASHES PICTURE at night when this setup is used to operate solenoid-actuated shutter. When animal stumbles into dark cord stretched across game trail, the cord yanks the trigger of the trap, tripping the camera shutter. Sharp impact of spring depresses release button (behind top of trap), taking picture. Rubber bands hold trap on.

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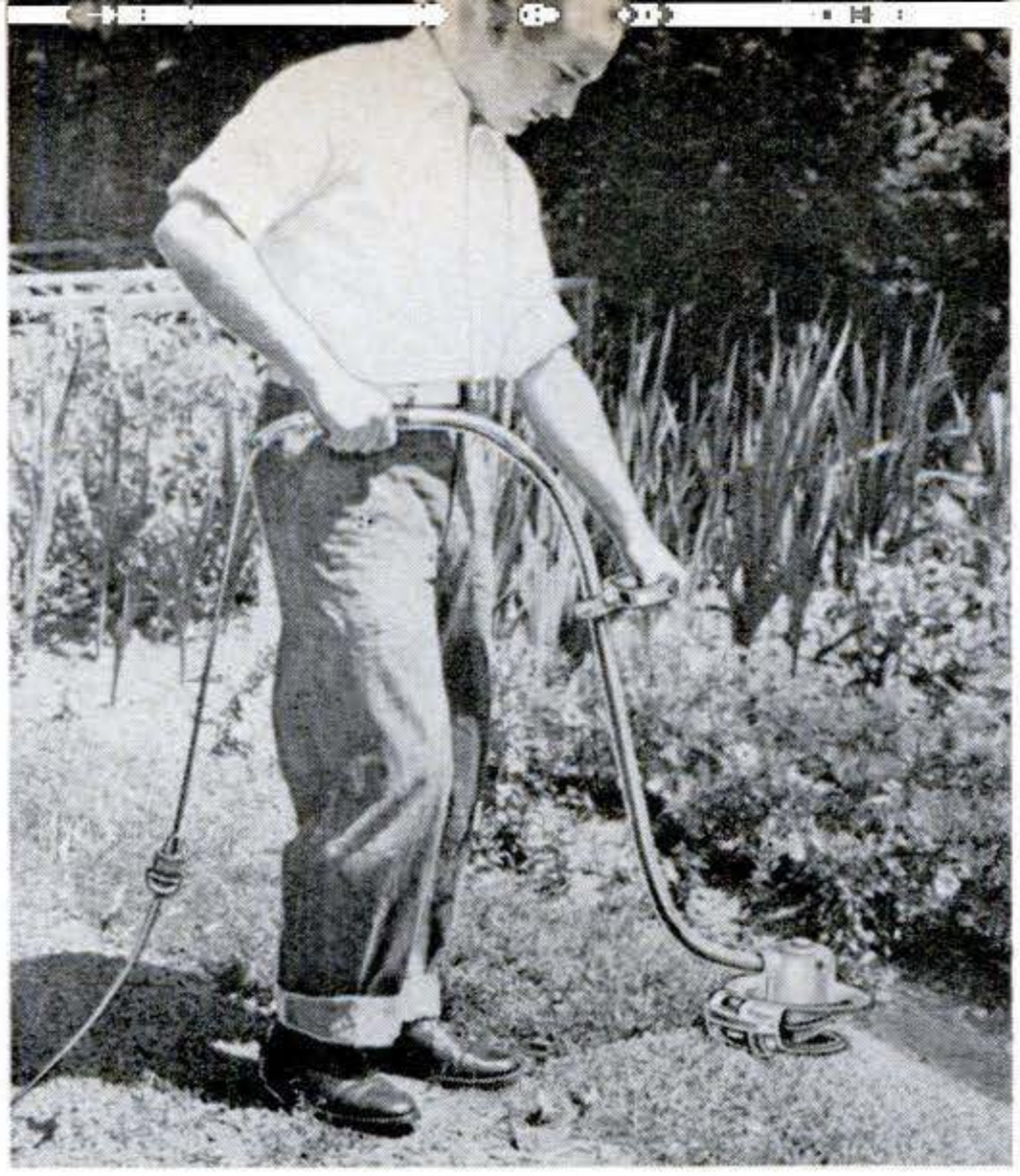
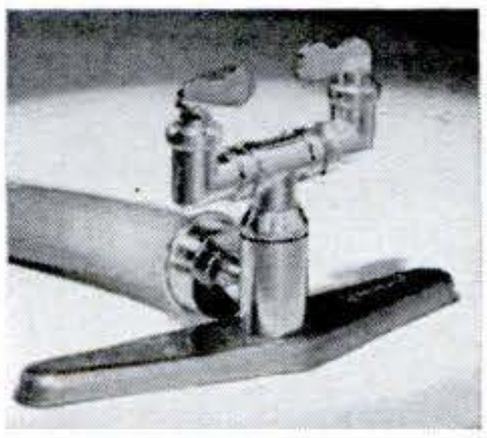


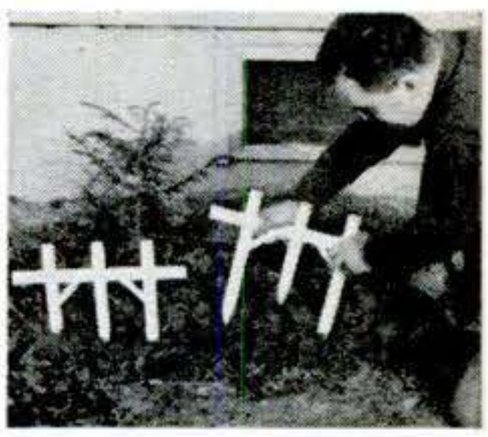
1. Trimming the Easy Way. You don't have to get down on your hands and knees to trim around lawns and gardens with this electric edger. Powered by a 115-volt motor, the rotary cutter is shock-mounted to prevent damage from obstructions. A guard shields the operator from flying dirt.

2. Planted Hose Sprouts Water. Dig a narrow slit in your lawn, press in this plastic sprinkler hose and you have a permanent underground watering system without harming your grass. The 100′ hose has eight spray nozzles 10′ apart, covers 800 square feet and will not corrode.

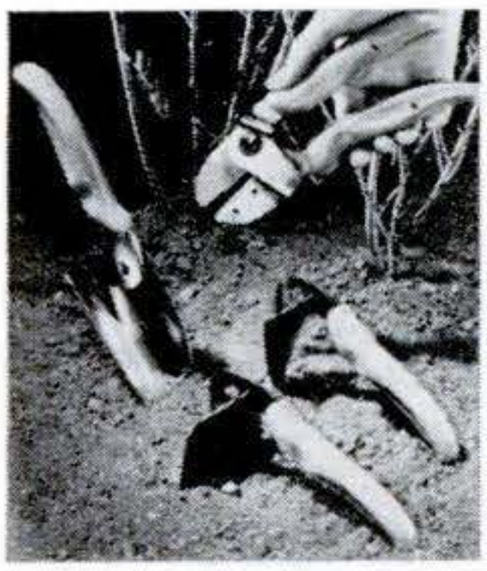
New Garden Gadgets



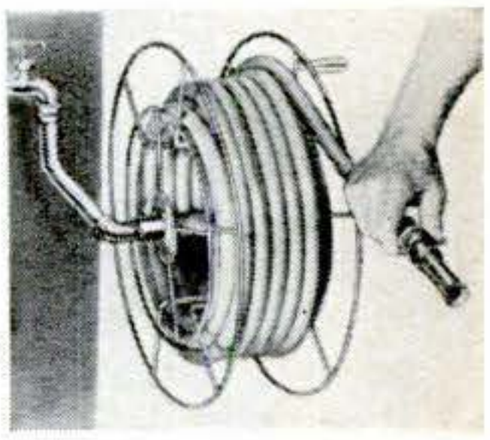
3. Two-in-One Sprinkler. The arm on this new lawn sprinkler revolves for a swirling spray or can be locked to provide a fixed stream in any direction. Two tiny spigots on the ends permit individual adjustment of each jet up and down and sideways. The spray also can be varied from a fine mist to a heavy downpour.



4. Prefab Fence. You can add a small fence to your lawn, garden or path by simply pushing these pointed plastic sections into the ground. Each section is 16½″ high and 14″ wide and meets other sections to form a continuous line. The white plastic is strong, won't rot or rust and does not need to be painted.



5. Four-Tool Kit. Four stub-handled tools for working at close quarters are packed in this gardening kit. The kit contains trowel, hoe, sharp-pointed cultivator and pruning shears. The matching handles are made of molded plastic, shaped to fit the hand for a good grip.



6. Reel Fits Faucet. This 100′ hose reel attaches directly to a faucet, eliminating permanent mounts and permitting it to be moved quickly from one faucet to another. Water flows into the hose through a swivel joint in the reel hub. A second swivel joint at the faucet permits the reel to be turned at any angle.

Further information on these products can be obtained from: 1. Stanley Electric Tools, New Britain, Conn.; 2. Baco Plastic Co., 201 N. Sycamore St., Santa Ana, Calif.; 3. Elkay Mfg. Co., 1401 W. 8th St., Los Angeles 17; 4. Hauser Products, Inc., 4034 N. Kolmar Ave., Chicago 41; 5. J. T. Henry Mfg. Co., Hamden, Conn.; 6. Craco Corp., 933 Air Way, Glendale 1, Calif.

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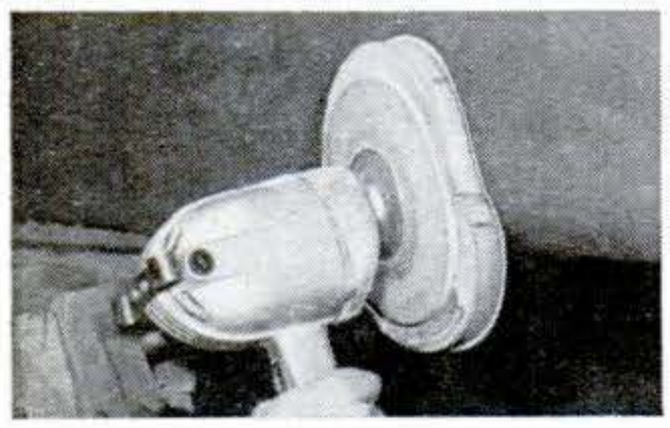
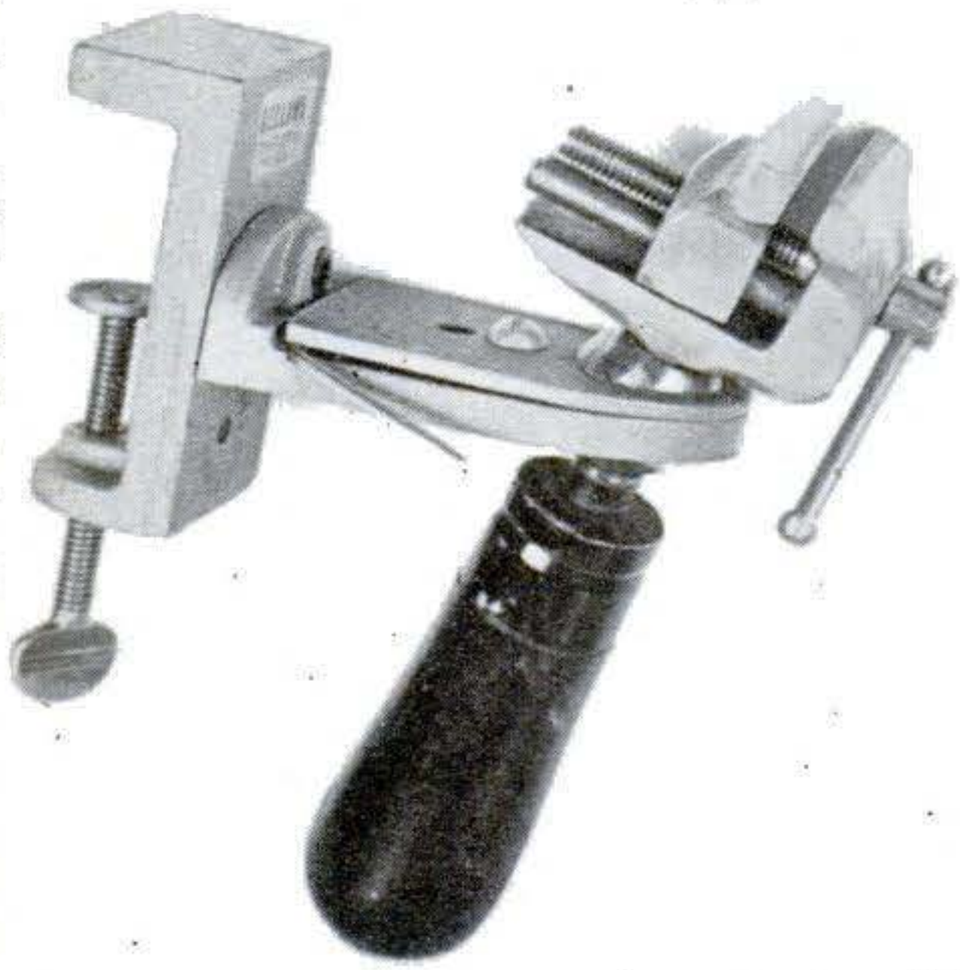
New Tools

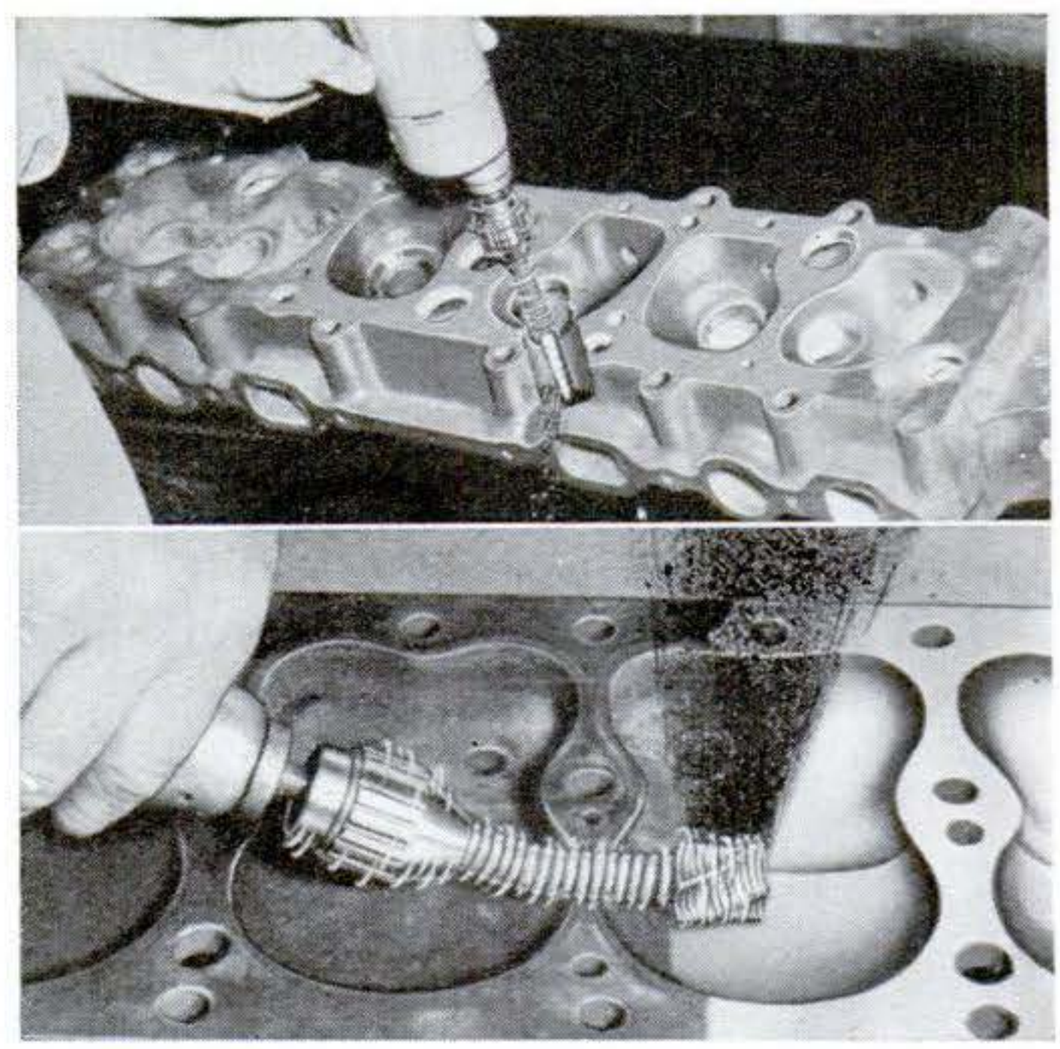
1 Tray Spreads Mortar Quickly. Fill this tray with mortar, run it along the top of a masonry wall, and it spreads a smooth, even bead of mortar right at the edge. Run another bead along the opposite edge and you're ready to lay the next course of blocks. The tray can be used on all types of bricks and blocks and has adjustable end gates that are raised or lowered to control the amount of mortar as it is dispensed.



2 Rubber Pad Sands Curves. The thick, flexible foam-rubber pad on this sanding wheel lets it follow curved and other irregular surfaces where stiff-backed disks wouldn't reach. A special adhesive on the face permits quick changing of sandpaper disks—you simply peel off the old one and press on the new one. The wheels fit ½″ chucks, or ¼″ chucks with an adapter, and come in 4½″, 5½″ and 8″ diameters.



3 Vise Tilts to Any Angle. Tiny, hard-to-hold parts can be gripped in any position in this small movable vise. It pivots in a ball-and-socket mount, can be moved by the wood handle below it and locked rigidly at any angle. Its 2″ jaws have a 2″ opening and can be replaced with interchangeable curved jaws for holding round stock. A model with 3″ jaws is also available.



4 Drill Removes Carbon. Caked-on carbon, weld slag, rust and other stubborn deposits can be quickly removed from metal with these rotary scrapers. They fit ¼″ electric drills and have flexible shafts for following curves and getting in recesses (bottom photo). A long, pointed scraper is used for cleaning out small openings like valve ports (top photo).

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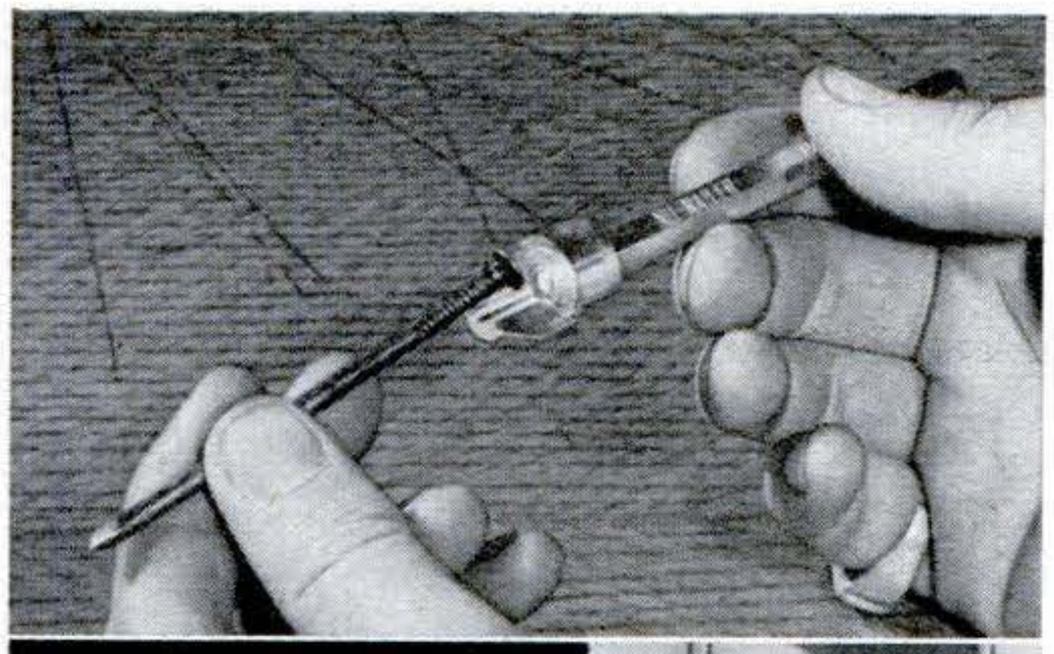
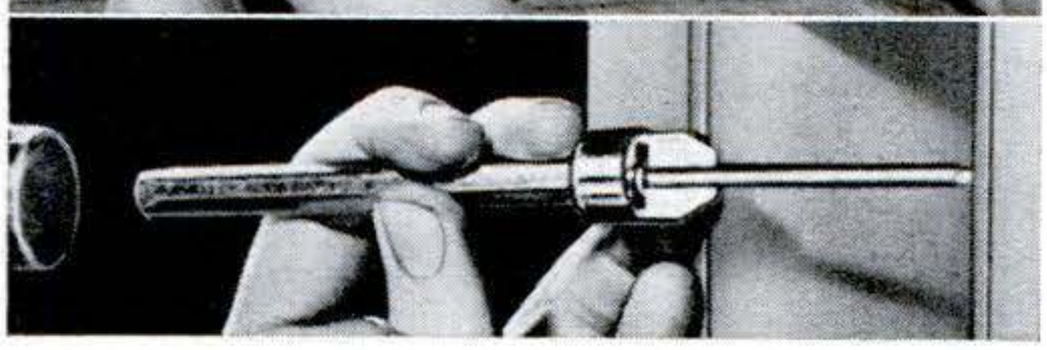
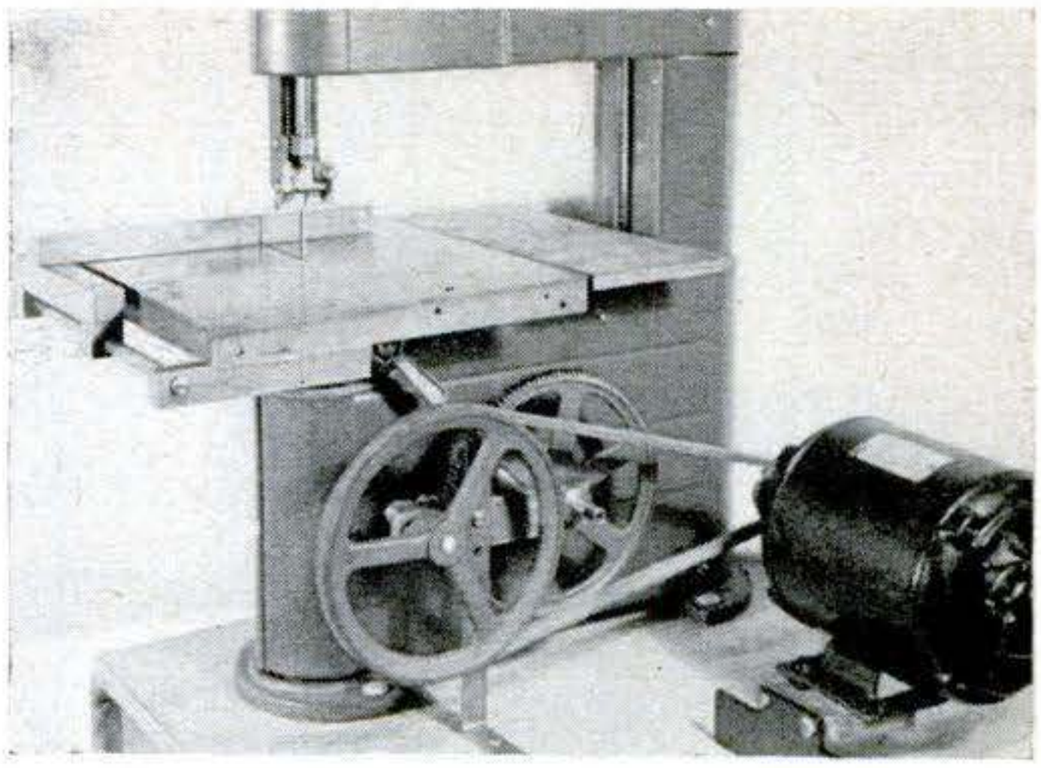
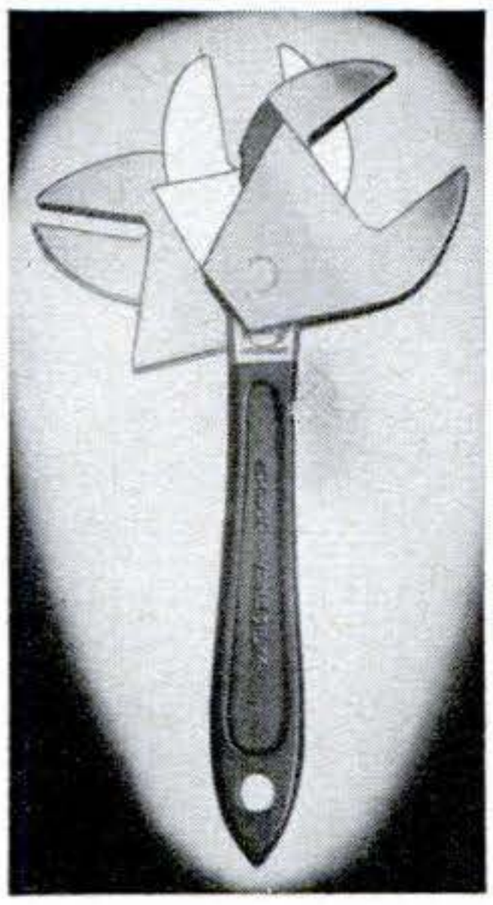




5 Holder Starts Nails. This holder grips a nail for you as you start it in grooves, corners or other hard-to-get-at spots, saving both your fingers and the finish from stray hammer blows. The slotted head holds all types of nails, including roofing and finishing, and the pointed tip can be used as a nail set for countersinking.

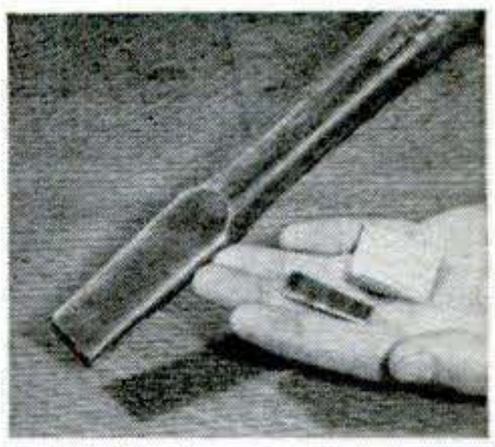


6 Bandsaw Attachment Cuts Metal. You can quickly convert an ordinary bandsaw to cut metal with this gear-reducer attachment. The special gear mounts between the bandsaw shaft and the original drive pulley, reducing blade speed to 200′ per minute for cutting metal. The saw can be switched back to wood cutting by shifting the position of the drive pulley and changing blades. The attachments will fit two-wheel bandsaws with up to 16″ wheels.

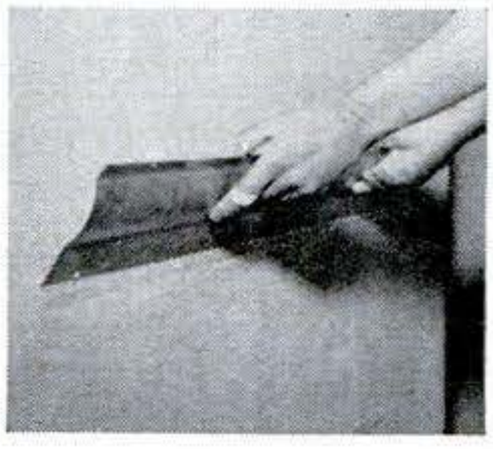


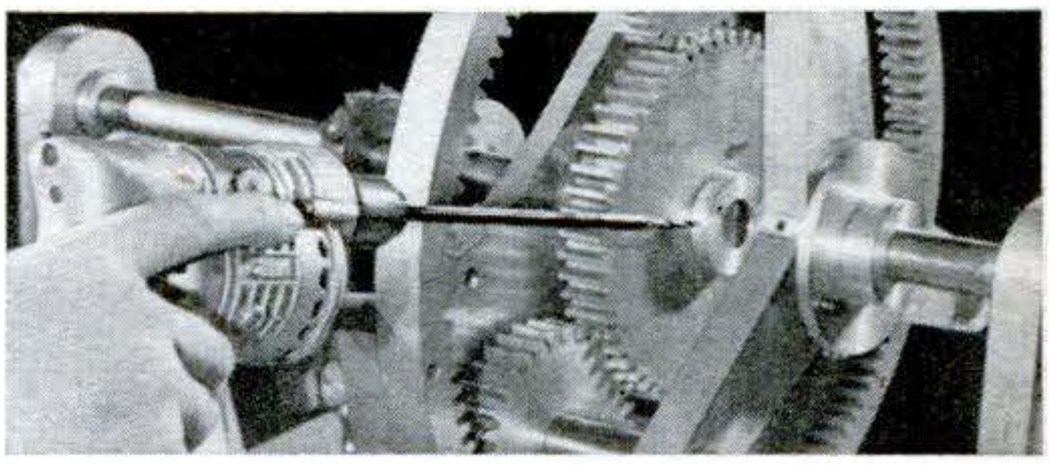
7 Wrench Adjusts to Nut. This open-end wrench will fit any nut from ¼″ to 1¼″. The jaws close as the head is pivoted around the handle, gripping the nut tighter the harder you push. In tight spots, the ratchet-like action lets you slip the wrench and retighten it without removing it from the nut.

8 Kit Rehandles Hammers. New handles for hammers and hatchets can be had in kit form to fit all types and sizes of heads. Each handle comes with a hardwood wedge and a metal cross wedge and instructions for installing it in five minutes.



9 Plaster Smoother Gives Any Finish. You can get any type of plaster finish from coarse to smooth just by varying the angle at which you hold this aluminum darby. Longer and lighter than conventional wood darbies, it's said to cover more area faster and reduce arm fatigue. It comes in four lengths from 36″ to 58″.





10 Extension Rod Holds Drills. This drill extension rod lets you reach deep drilling locations without buying special long-shank drills or having to braze your own extensions. The rod is 8½″ long and fits ¼″ chucks. Individual chucks, fitting the end of the rod, are available for drill sizes from No. 52 to No. 10 and 1/16″ to 3/16″ by 64ths.

Further information on these tools can be obtained from: 1. Kakest Co., Curwensville, Pa.; 2. Carborundum Co., Niagara Falls, N.Y.; 3. Bellows Mfg. Co., 1017 N. Central Expressway, Dallas, Tex.; 4. Thorsen Tool Co., Oakland, Calif.; 5. Pollock Engineering Co., 10342 So. Church St., Chicago 43; 6. Raylen Products, 198 River Meadow Drive, Rochester 18, N.Y.; 7. Fuller & Hellmann, Inc., Moro, Ore.; 8. Fayette R. Plumb, Inc., Philadelphia, Pa.; 9. C. D. Contracting Co., 2051 McKee Ave., S .W., Grand Rapids, Mich.; 10. Beaver Tool Co., Box 298, Huntington, L. I., N. Y.

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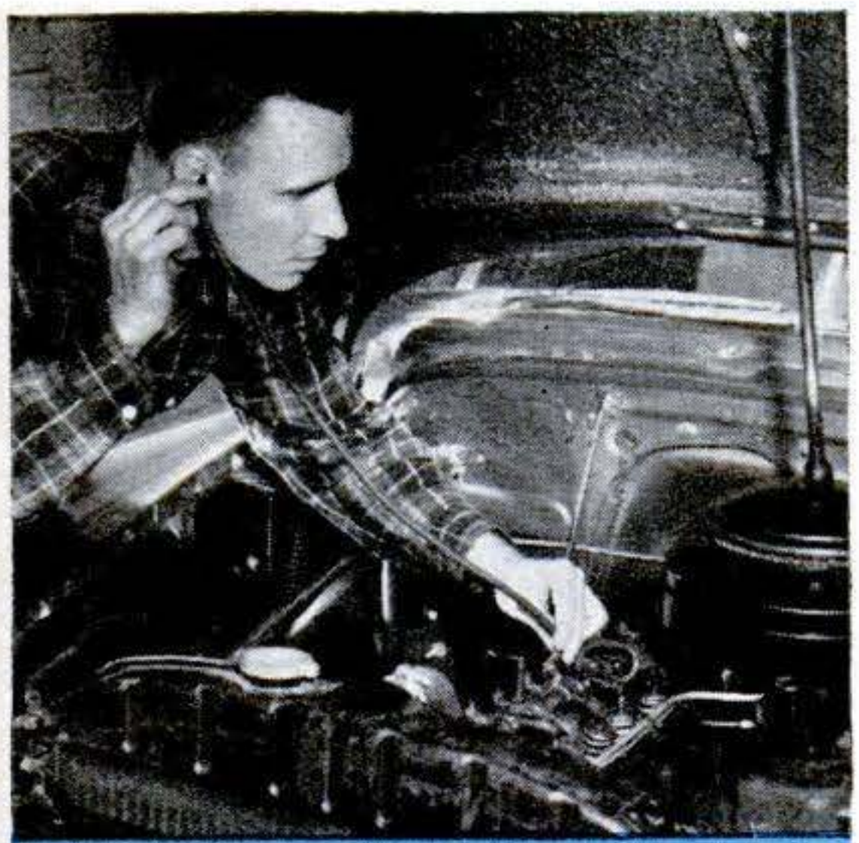
How to Cure Noisy Valves



Hydraulic lifters in some of the new cars may set up a clatter unless kept oiled. Here's what to do to shush them.

By Basil Hoover

"HYDRAULIC valve lifters are fine as long as they work the way they're supposed to," said a friend of mine the other day. He had just taken his car to a repair shop to have a clicking valve fixed, and was complaining because he thought the labor charge was too high. "Valves used to get noisy on my old Chevvy," he grumbled, "but it took only about 30 minutes to adjust them."

I felt like telling him that he should have changed the oil before it got dirty enough to cause trouble; but I'd often told him that. So I merely made some vague remark about everything having disadvantages.

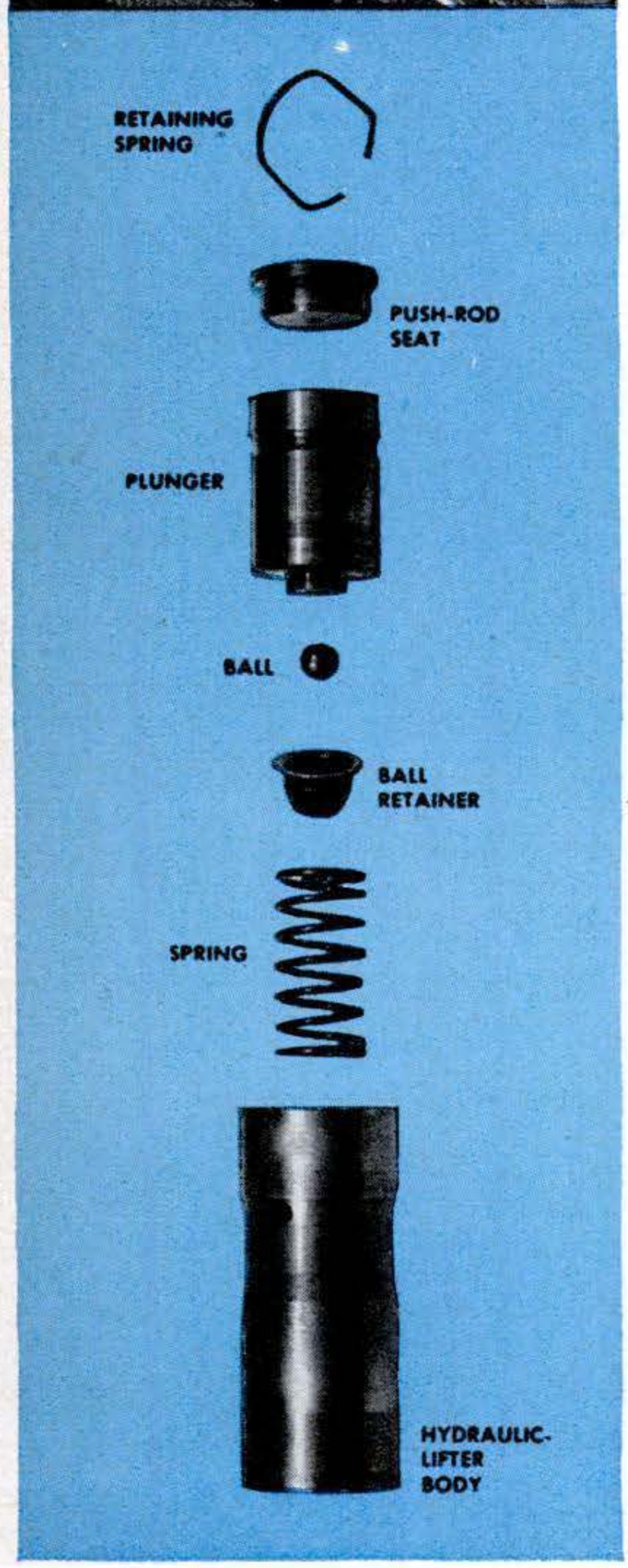
The hydraulic valve lifter has become widely used during the past few years. Buick, Olds, Lincoln and Cadillac use it, for example; and when Chevrolet offered the Power-Glide model in 1950 the engine was equipped with hydraulic valve lifters. Perhaps the lifter is most appreciated by Power-Glide owners because it has hushed Chevvy's notoriously noisy valves.

A properly functioning hydraulic valve system is practically noiseless. Noise is a sign of trouble. Fortunately the trouble can be corrected by anyone who is moderately skillful at working on an engine.

Cleaning may stop noise. A noisy hydraulic valve lifter is usually dirty. The regular motor oil circulates through the lifter and dirt and gum from the oil tend to collect in it. While the cleaning process is not difficult it is time-consuming. If you are a car owner who keeps an eye on the pocketbook you may prefer to consume your own time instead of your money.

With the exception of one adjustment, the same procedure can be used in servicing hydraulic lifters on both the Power-Glide Chevrolet and the Dyna-flow Buick.

The valve-in-head V-8 engine used by Olds and Cadillac has a hydraulic valve lifter that is fundamentally the same as that used by Chevrolet and Buick. The method of removing valve lifters from the V-8 motor is different, but not difficult.



THESE ARE THE PARTS of a typical hydraulic valve lifter. Used like a stethoscope as in the photo above, a rubber hose will help you locate a noisy lifter.

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If you want to work on Chevrolet valve lifters simply follow the method described and illustrated here. If you have a Buick, Olds, or Cadillac, note the variations that apply to your particular car.

Locating a noisy lifter. One quick and easy way to locate a troublesome valve lifter is with a piece of rubber hose, used stethoscope fashion. With the motor idling hold one end of the hose to the ear and place the other end against the rocker arm. If the lifter is functioning properly a dull, scarcely audible click will be heard, combined with the cushioning sound caused by the oil in the lifter. If the lifter is faulty a hard, sharp click will be heard through the hose. Some experienced mechanics can locate bad lifters by putting their fingers on the rocker arms while the motor is running. The amateur mechanic, however, can do better with the makeshift stethoscope.

The hydraulic valve lifters are located at the lower end of the push rods and operate directly off the camshaft. They can be reached by removing the push-rod cover plate from the side of the motor.

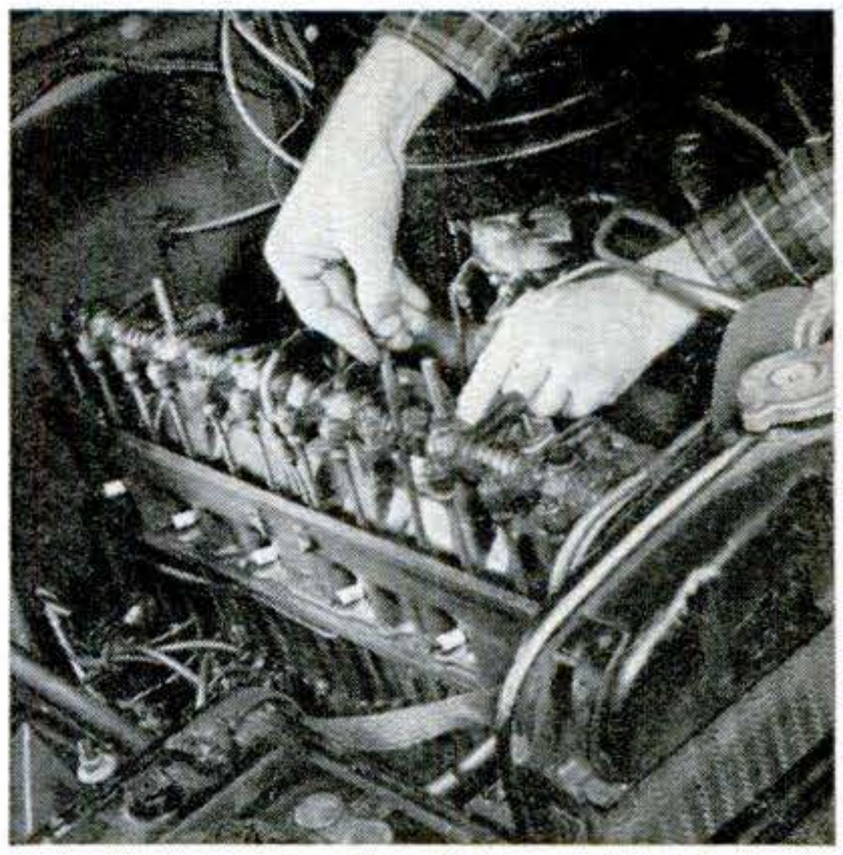
Removing the lifter. After the noisy lifter has been located and the push-rod cover removed, the next step is to take out the push rod. The easiest and quickest way is to slide the rocker arm to one side and lift the push rod out beside it. In doing this, first make sure that the rocker arm is not holding the valve open. Then loosen the adjusting screw all the way. The arm can then be moved sideways and the rod lifted out. Another method is to unbolt and remove the entire rocker-arm assembly.

When the push rod has been taken out insert a hooked wire in the top of the lifter unit and lift it out of the engine block.

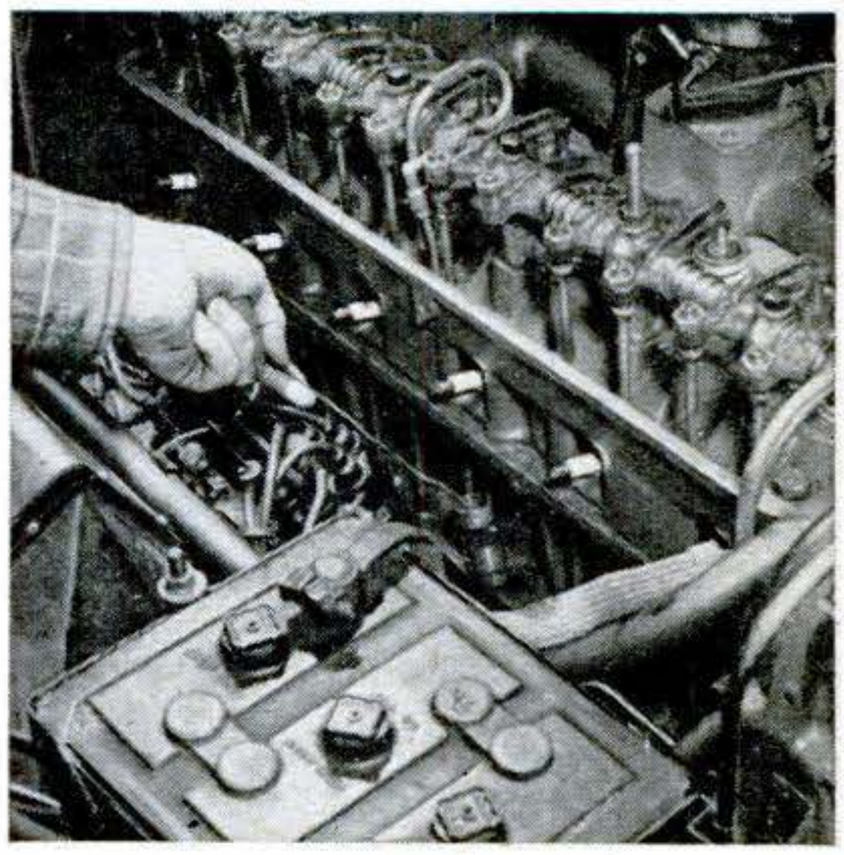
The lifter is made up of seven parts. Disassemble the unit by removing the small spring at the top—but before this can be removed the plunger must be depressed slightly. If you try to push the plunger down with a small screwdriver handle or any other blunt object you will find it practically impossible because of the oil pressure within the lifter.

The secret is to insert a small object about two inches long through the hole in the top of the plunger. A pin punch, small Allen wrench, or even a piece of stiff wire may be used. Pushing down on the small tool releases the oil pressure by holding open the ball-check valve at the bottom of the plunger.

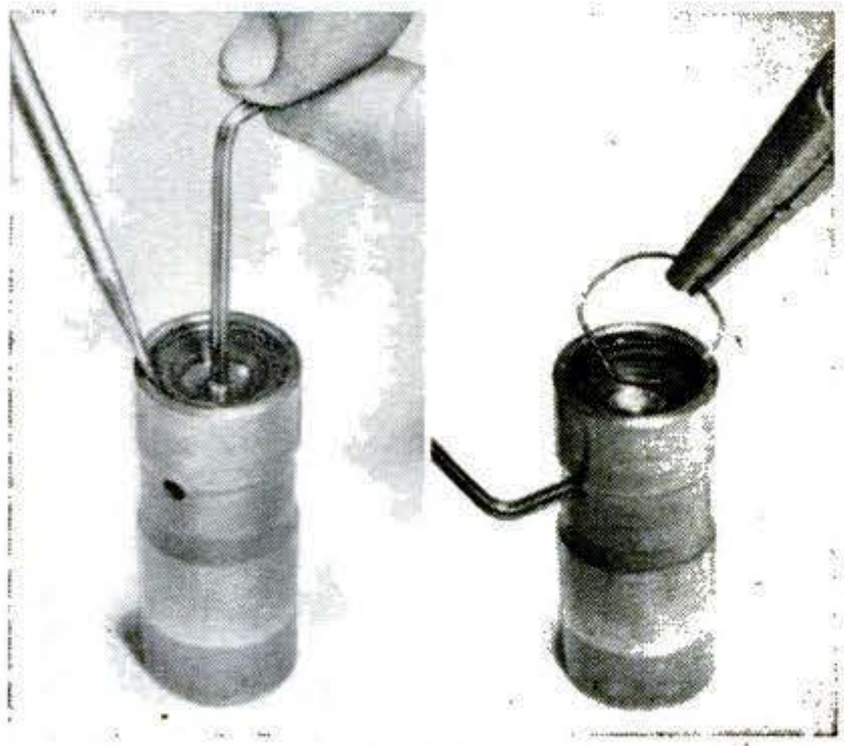
Checking a lifter. After taking the unit apart clean it thoroughly. Then inspect the various parts for defects. The plunger should move freely in the body but should not be so loose that it wobbles. The most important thing is the ball-check valve. Make sure the ball doesn't have a flat side and that it is seating properly. If any of the parts are defective you will save time and trouble by buying a new lifter unit. When reassembling the lifter, line up the



FIRST STEP in having a look at a Chevvy lifter is to slide rocker arm to one side and lift the push rod out beside it, as is being done above.



TO LIFT THE LIFTER from the engine block so you can work on it, bend a hook in a piece of wire and insert the hook in the top of the lifter.



TAKE LIFTER APART by inserting a small Allen wrench through hole in top as at left to depress plunger and free the retaining spring. After cleaning, reassemble the lifter by inserting the wrench through aligned holes to hold down the plunger while the spring is being replaced.

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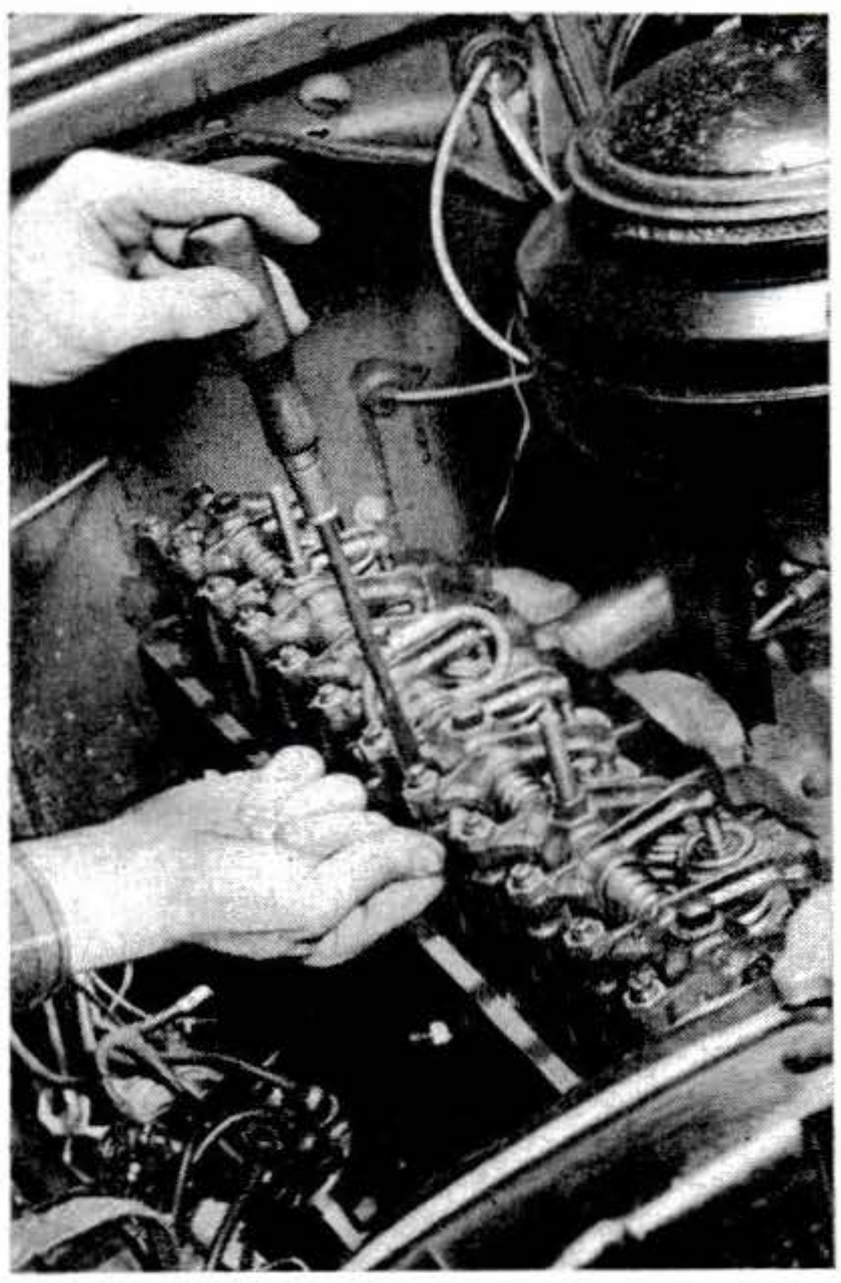
hole in the side of the plunger with that in the body. Push the plunger down until the two holes are aligned and put a small Allen wrench through the holes to keep the plunger down while the retaining spring is being replaced. After the lifter is reassembled fill it with the same oil that you are using in the motor.

Lifter parts are not interchangeable, and to avoid the danger of getting parts of different lifters mixed it is best to disassemble only one unit at a time.

Making final adjustments. In finishing up the job the rocker-arm screws must be readjusted. This adjustment is extremely simple—much simpler than with nonhydraulic valves.

First make sure the camshaft is in the closed-valve position. If a lifter on cylinder number three, for example, is being adjusted remove the distributor cap and crank the motor until the rotor points to the number three high-voltage contact and the breaker points are open. The piston is then at the top of the cylinder and both valves are closed.

Next, take hold of the push rod with one hand and gently jiggle it back and forth sideways as you screw down the rocker-arm adjustment. By jiggling the rod slightly you will be able to tell when the adjusting screw makes firm contact with it. As soon as this occurs—when you can't jiggle the rod any more—stop. Then carefully screw the adjustment down exactly one and one-half turns more. That's all.



FINAL ADJUSTMENT on a Chevvy rocker arm is a one and one-half turn of the screw. For a Buick adjustment allow two full turns.

The valve-lifter plunger can travel a distance in the body cylinder equivalent to three turns of the adjusting screw. One and one-half turns places the plunger in the midpoint of its travel.

The Chevrolet adjustment is one and one-half turns; but on the Buick the correct adjustment is two turns of the screw after it makes contact with the push rod. Otherwise Buick valve lifters can be removed and serviced according to the procedure described for Chevrolet.

Working on other cars. On the new valve-in-head V-8 engine used by Olds and Cadillac the lifters are located in the V between the two cylinder banks. Before the lifters can be reached the intake manifold must be removed. Under the manifold is a valve-compartment cover plate. The disassembly job sounds more difficult than it actually is because the manifold can be taken off rather quickly and the compartment cover presents no problem.

The rocker arms on the V-8 engine have no adjusting screws. All parts of the assembly are fitted to close tolerances and it is extremely important not to interchange any parts of the valve system whatsoever.

Push rods on the V-8 engine can be removed singly without unbolting the entire rocker-arm assembly. Since there is no adjusting screw the valve spring must be depressed before the rocker can be slid to one side.

Hydraulic lifter units on Olds and Cadillac are smaller than those on Buick and Chevrolet, but the basic design is the same.

Are lifters getting oil? When servicing the V-8 engine be sure to inspect the passages that feed oil to the lifters, for oil starvation will cause noisy operation. If you remove a lifter and find no oil in it, the short passage leading from the longitudinal oil header to the lifter bore is clogged. This passage is a visible opening in the side of the lifter bore. A clogged oil passage is a common trouble on the V-8 engine.

When you've finished servicing the lifters on an Olds or Cadillac, merely put the motor back together. There is no valve adjustment to make.

Where hydraulic valve lifters are concerned, an ounce of prevention is worth a pound of cure. The prevention is simply clean oil. But once the lifters start clicking it is too late for prevention. END

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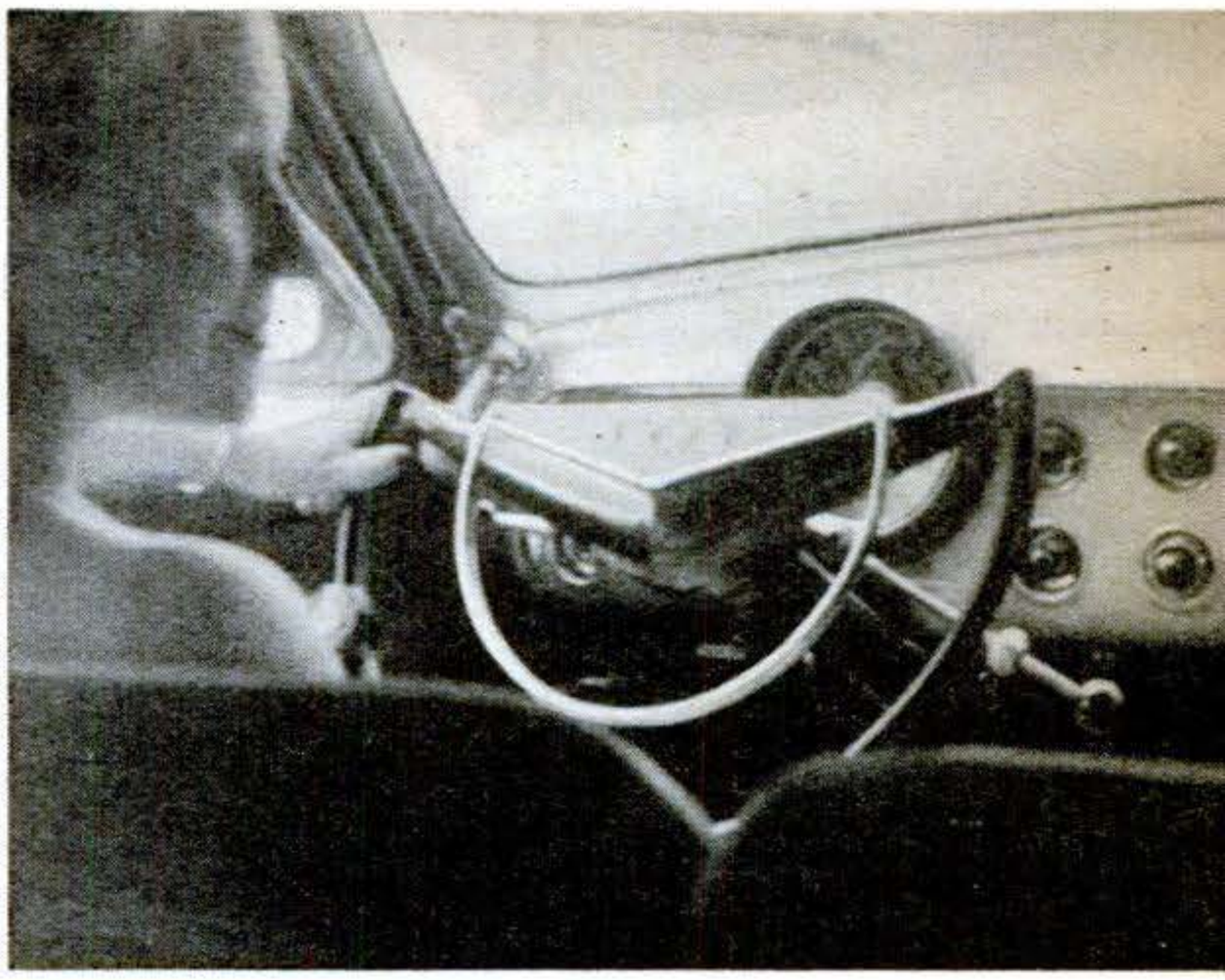
Cut-Down Steering Wheel Gives Wide-Open View Ahead



My cut-down steering wheel gives me a better view of the road ahead, and I don't have to crane to check the instruments. By giving the crescent half a turn, I can slide in or out of either side of the car with ease, or swing completely around to get at anything stowed in back.

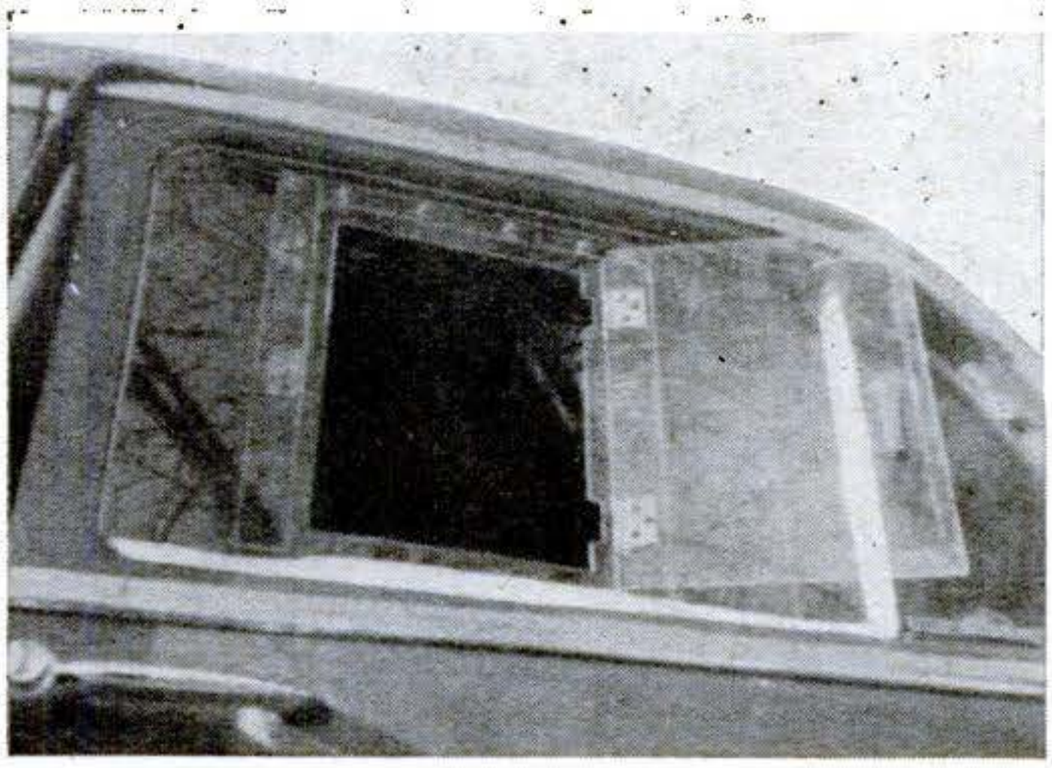
As a veteran steering-wheel doctor—I've operated on 10 cars during the past 14 years—I've found that for easy turning the remaining crescent should encompass a bit more than 180°, and that a wheel spinner is a real help.

To cut down a wheel I simply remove it, clamp the unwanted section in a vise, and hacksaw it off, leaving some material for finishing with a file. Emery cloth, followed by buffing or a coat of clear lacquer, restores the gloss of the plastic or rubber. The horn ring gets the same cut-down treatment.

Some modern wheels have two spokes, arranged in the form of an inverted "V." Such a wheel must be remounted upside down to give a large enough surface for steering. That means that a new keyway must be cut in the hub or, if the hole is serrated, a notch must be cut in the ungrooved surface, before the wheel can be inverted.

Whenever a wheel has to be turned upside down, make sure to index the directional light cam.—*John Kany, Dearborn, Mich.*

Mail Delivery Window-Door



A window-door, made of ⅛" clear plastic, saves time on my Rural Free Delivery route. It is the same size as the regular window, but has a large hole cut in the center, framed by strips of clear plastic cemented in place and set off by decorative brass bolts. The door, also of plastic, is attached with two butt hinges, and has an inside locking handle.

To install the window-door I crank down the regular window, remove the molding, and slip the plastic member in the casement. Because the hinges are at the front, air pressure automatically closes the door. —*Wilmer S. Geissinger, Quakertown, Pa.*

Clamp Makes Ring Compressor

A strip of sheet metal and a hose clamp of the type which uses a worm screw for tightening make a handy and inexpensive compressor for occasional ring jobs. The sheet metal should be several inches longer than the ring circumference, and the clamp which compacts it has to be lengthened by cutting it opposite the screw and riveting ends to box strapping. —*K. Heryford, Cedarville, Calif.*

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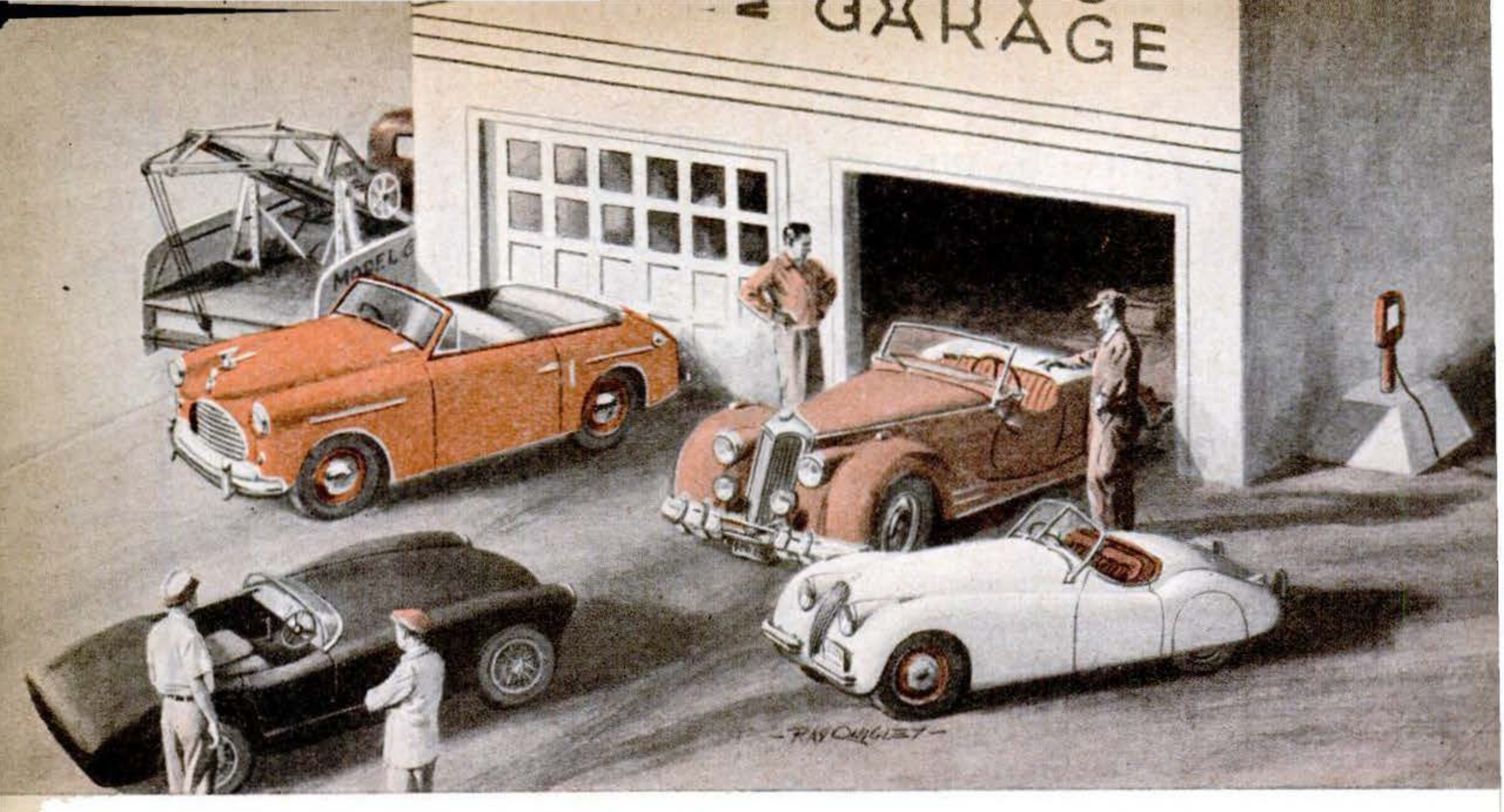

GUS PUTS THE HEAT

Barnes was a big wheel at the local bank, but he was banking on Gus to cure his MG in time for the road races.

GUS WILSON was just finishing up a brake adjustment when Stan Hicks, his young helper, came back into the repair shop.

"The foreigners sure are taking over," Stan said.

"Foreigners?"

"Yeah, those snazzy foreign cars. Bet I've gassed up half a dozen this morning."

"Oh, sure. Didn't you know about the road race the sports-car boys are holding out on the Mill Road Saturday? They'll probably be coming to town from all over."

Gus did a double-take when he saw who was driving the little sports car.

During the next few days, the Model Garage looked almost like a petrol station on the Continent. By the time Friday afternoon came around, Gus had poked his head under the hoods of more Healeys, Allards, Romeos, MGs, Jaguars and Ferraris than he had ever seen before.

It wasn't until late Friday that Gus was able to take a breather. "Well, Stan," he said, "looks like the rush is over. I'm going to call it a day."

But Gus had no sooner got the words out of his mouth than he heard a car pull up.

"Sounds like another foreigner," said Stan.

It was a trim little black MG with the top down. The big man driving it made it look even smaller.

"Something we can do for you?" Then Gus did a double-take.

The man at the wheel bore a remarkable resemblance to J. B. Barnes, president of the local bank. Of course it couldn't be Barnes. Gus looked closer and his jaw dropped. Maybe it couldn't be, but it *was*.

Gus had banked at Barnes's institution for several years and he serviced the financier's

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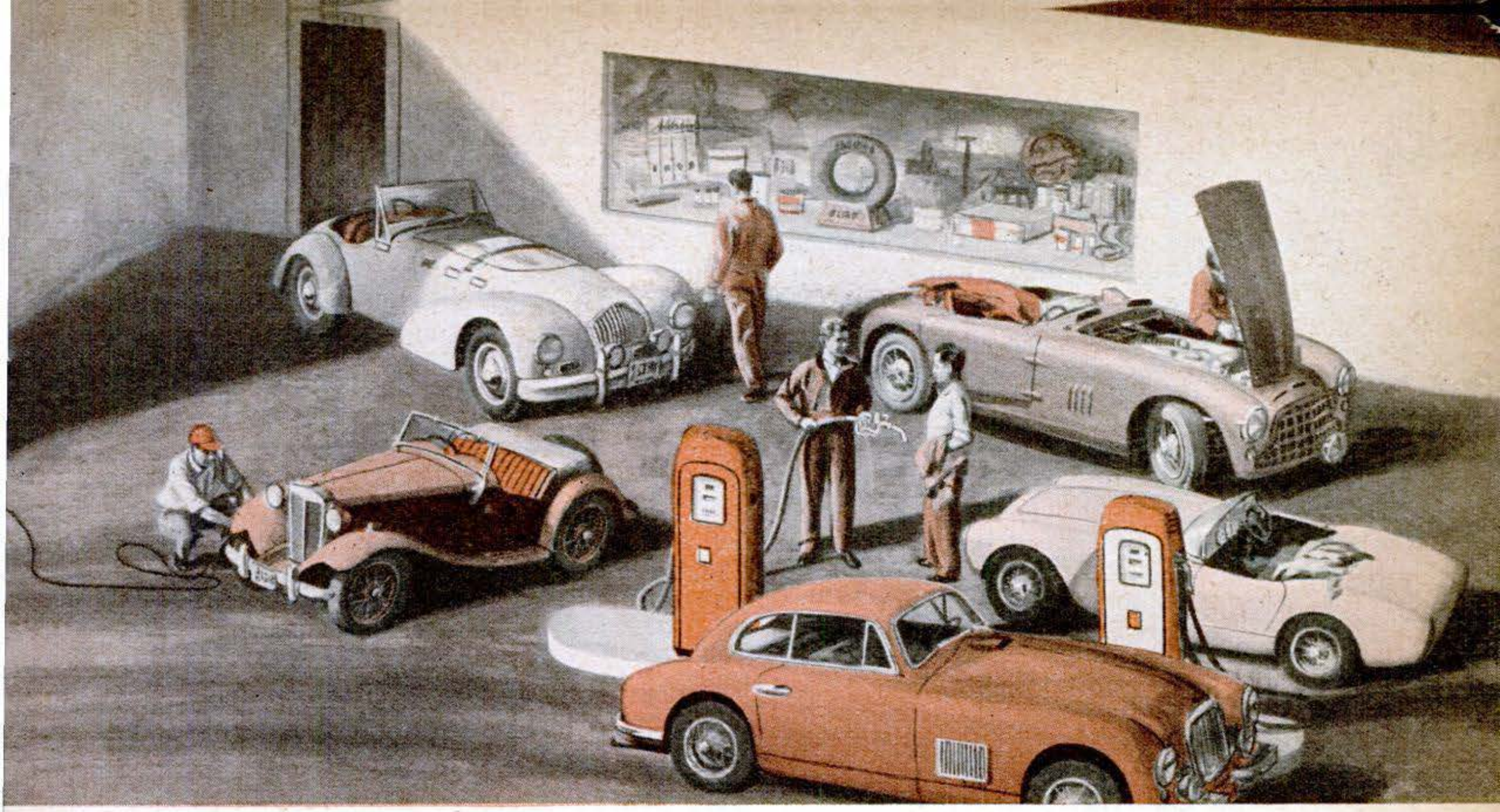

ON AN MG

BY MARTIN BUNN

imposing limousine regularly, but he never expected him to turn up in a leather windbreaker and old cap, driving a midget car.

Grinning, J.B. was extricating himself from the driver's seat. "No, you're not seeing things, Gus," he announced jovially. "And it's not as funny as you might think. Used to be a scorcher in my younger days. Drove a Stutz Bearcat—there was a car for you! Even did a bit of dirt-track racing."

"No kidding," Gus said admiringly. Things began to add up. "Say, I'll bet you're going in that road race tomorrow."

"You guessed it, and that's why I'm here. I had a chance to pick up this MG at a bargain the other day and couldn't resist it. Doc Tandy says I ought to get my mind off business once in a while anyway and—well, I thought I might as well try my luck tomorrow, just for fun."

"Good for you. But what's wrong with the car?"

"Well, this afternoon when I made some trial runs over the course, I couldn't coax much more than 65 out of her. On the straightaways, the rest of the boys were going by me like I was anchored."

"Drive her into the shop," said Gus, "and we'll have a look."

When Barnes had parked his little MG in front of Gus's bench, Gus climbed into the driver's seat and pushed down slowly on the gas pedal. At low speed it ran fine, but when Gus gave it the throttle, the engine seemed to get sluggish and mushy, as if it didn't want to take the gas.

"Could be the timing's off, or you may have a bum carburetor," said Gus as he checked the ignition system carefully. But a timing check showed nothing out of line. Then he went to work on the carburetor.

Again he found nothing. The fuel pressure was up, the float level was right, and nothing seemed to be blocking the jet or the fuel lines.

Gus Questions Barnes

"Any other symptoms, besides that sluggishness?"

Barnes thought for a moment. "Well, she seems to run a little on the warm side," he said finally, "but I don't think she overheats enough to cause any trouble."

"How is she on gas?"

"Well, it's hard to tell in the short time I've had her, but offhand I'd say she uses more than she should."

Gus said nothing as he climbed back into the car and started the motor again. After tromping on the accelerator several times he climbed out, put his head close to the

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engine block and began racing the motor by working the throttle lever on the carburetor.

"H-mm, that's funny. Sounds like there's a trace of a spark knock." He turned off the ignition and loosened one of the plugs.

"Save your knuckles, Gus, if you're aiming to check for carbon," said Barnes. "That engine had a complete carbon job before I bought it. And those plugs are brand-new."

"Hey," Gus said, with a grin, "you're knocking down my hunches even before I hatch 'em. Well, let's see if the vacuum analyzer can turn up anything else wrong."

Stan wheeled out the portable analyzer panel and connected the vacuum tester.

At idling speed, the needle on the gauge held steady at just about the right spot to indicate a fairly healthy motor. However, as Gus pushed down slowly on the accelerator, the needle began to get nervous. It would go up to a high reading, snap back to a low reading, and then climb back up. As Gus increased the engine speed, the needle snapped back closer and closer to zero and didn't climb back quite so far.

"Well, you can chalk up one against Wilson," muttered Gus as he watched the needle's gyrations. "Unless that gauge is as screwy as my last few hunches, about all that ails this car is a partially clogged exhaust system."

Gus shut off the motor, walked to the rear of the car, kneeled down, and squinted into the end of the tailpipe. Then he probed around with a long-handled screwdriver.

"You see," said Gus, "it's badly coated with carbon and the muffler's probably even worse. These MG tailpipes are pretty small anyway, so the carbon's been building up back pressure."

Gus walked over to the corner, got his creeper and rolled it over to the car.

"Whoa, boss. You'll never make it," said Stan. "And it won't fit on our grease rack either. Wait a minute and I'll have her up on screw jacks."

When Stan had the jacks in place, Gus slid under. About a minute later he reappeared with a rather glum look.

"That blamed exhaust system is all in one piece from the manifold right down to the tip of the tailpipe. No way of taking it apart. I'd hoped maybe we could clean it out."

"How about cutting it apart?" offered Stan.

"No. I tell you what you do, Stan," Gus said after a glance at the shop clock. "Get right on the phone and call the Davis boys down in the city. They handle some parts for foreign cars. If they have an MG exhaust assembly tell them to stay open a little longer and I'll pick it up."

Stan disappeared into the garage office as Gus slid under the MG again.

"Anything I can do to help?" Banker Barnes sounded as worried as if a million-dollar investment had gone sour.

"Nope," came back Gus's muffled voice. "I just thought I'd get a head start by disconnecting the exhaust from the hangers."

Gus was working away at the last rusty bolt when Stan's face appeared under the car. "No luck, boss. They haven't any in stock and claim it'll take at least a week to snag onto one."

"Well, I guess that scratches me from the race," the big man said glumly as Gus reappeared from under the car.

"Now hold your fire a minute," Gus kidded. "Stan, roll the acetylene welding rig out back while I unlatch the front end of this exhaust system."

A few minutes later, standing in the open lot back of the garage, Barnes and Stan watched while Gus propped the MG's one-piece exhaust up on an old metal drum so that the manifold end was high in the air while the tailpipe was on the ground. Then

[Continued on page 248]

GAS BUGGY DAYS

THE first agitators for improved roads in the U.S. were the cyclists. In 1900, the bicycle brigade was 10 million strong. At that time only 8,000 automobiles were registered in this country.

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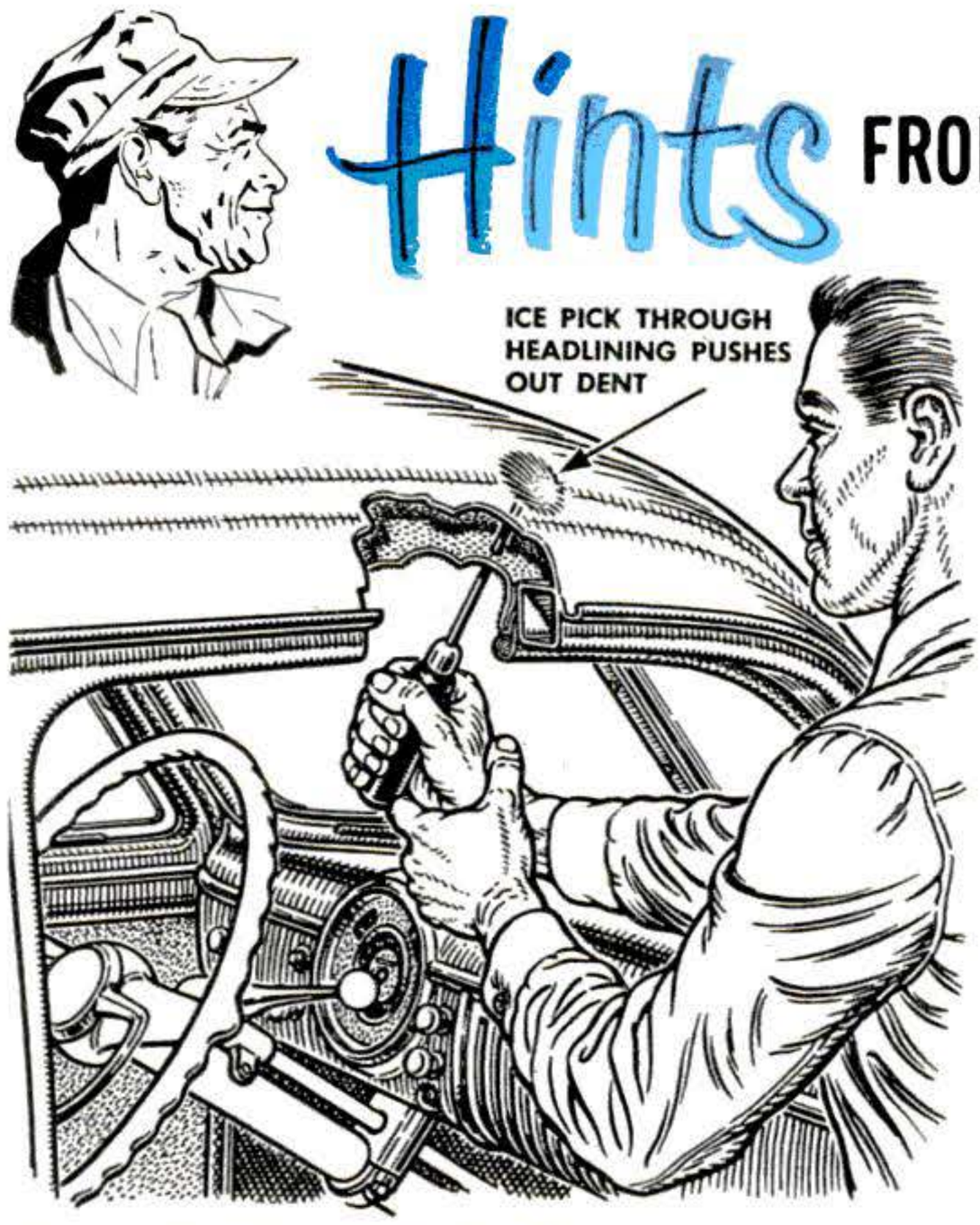
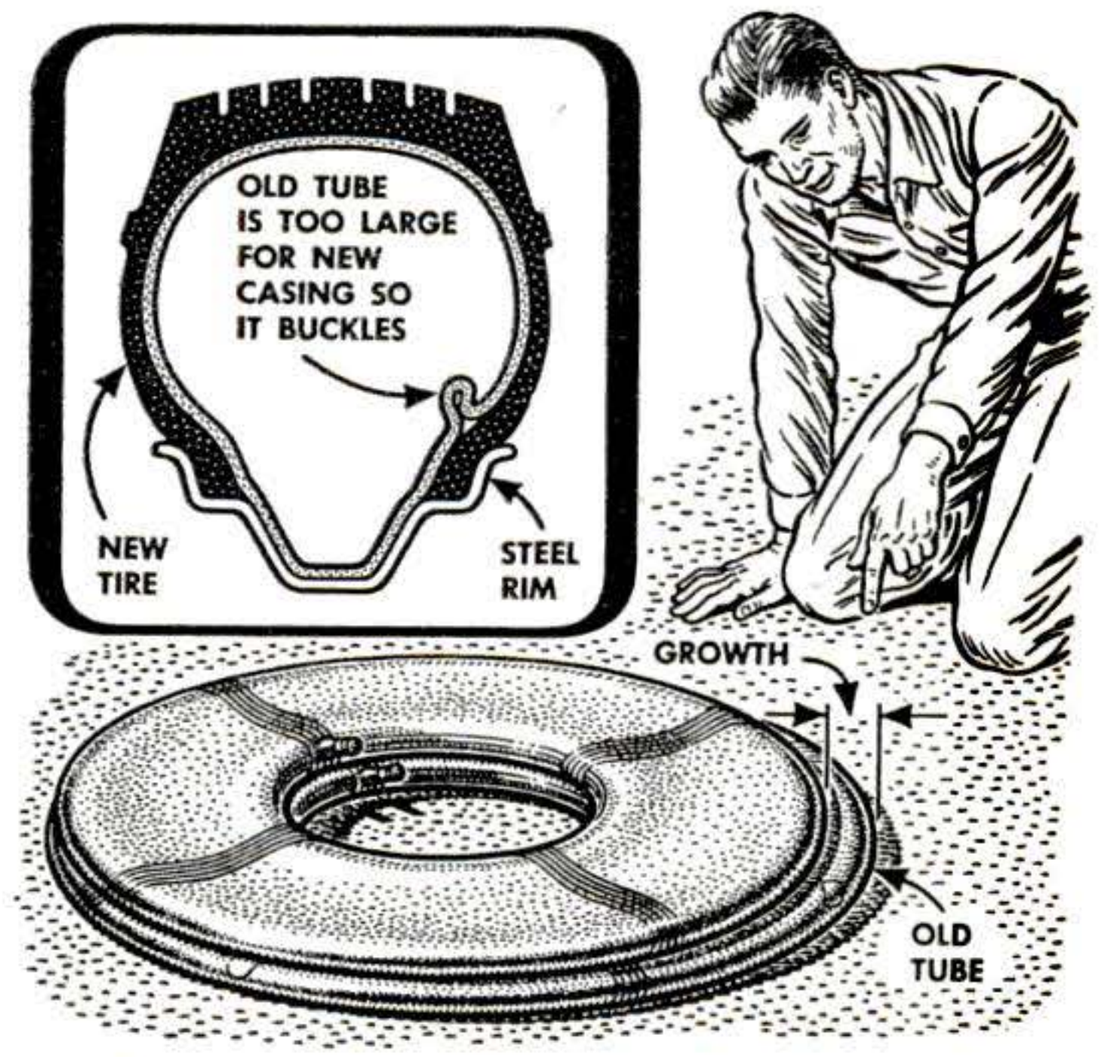
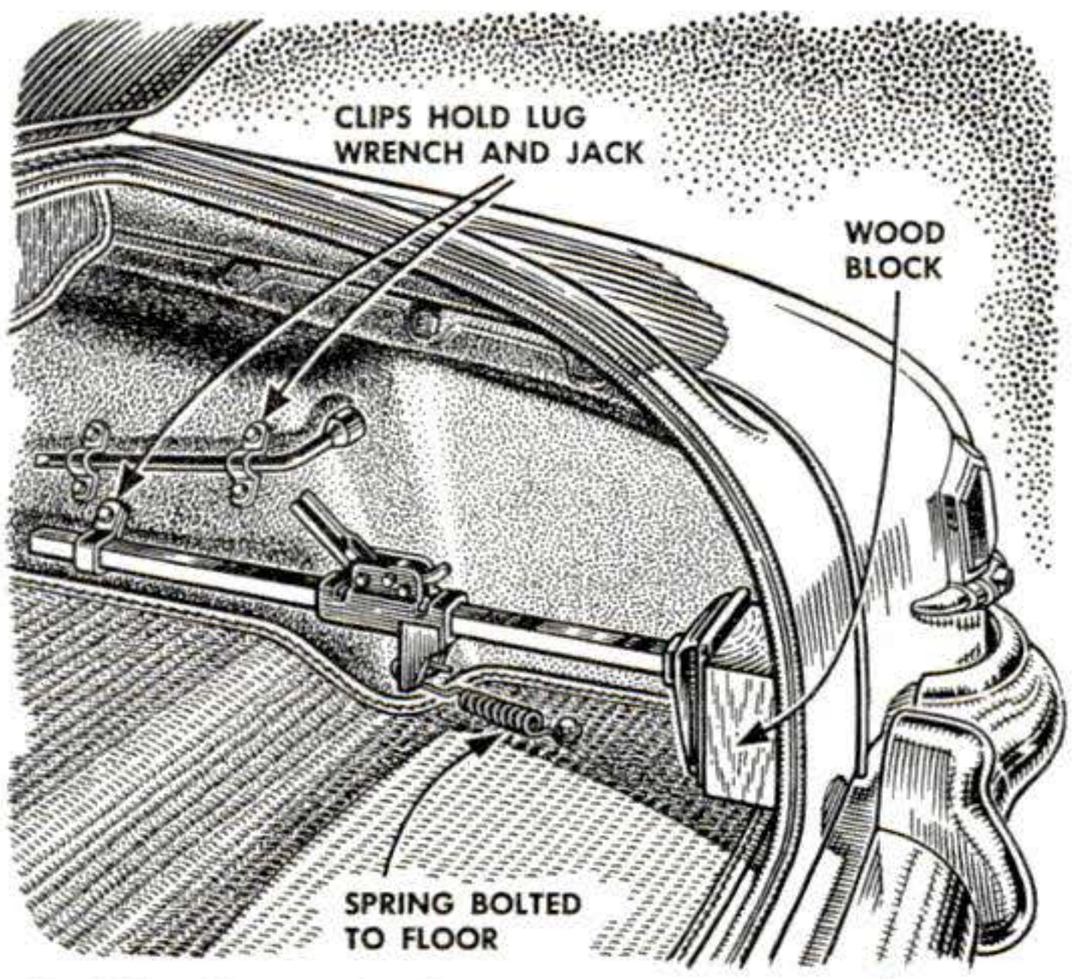
Hints FROM THE MODEL GARAGE



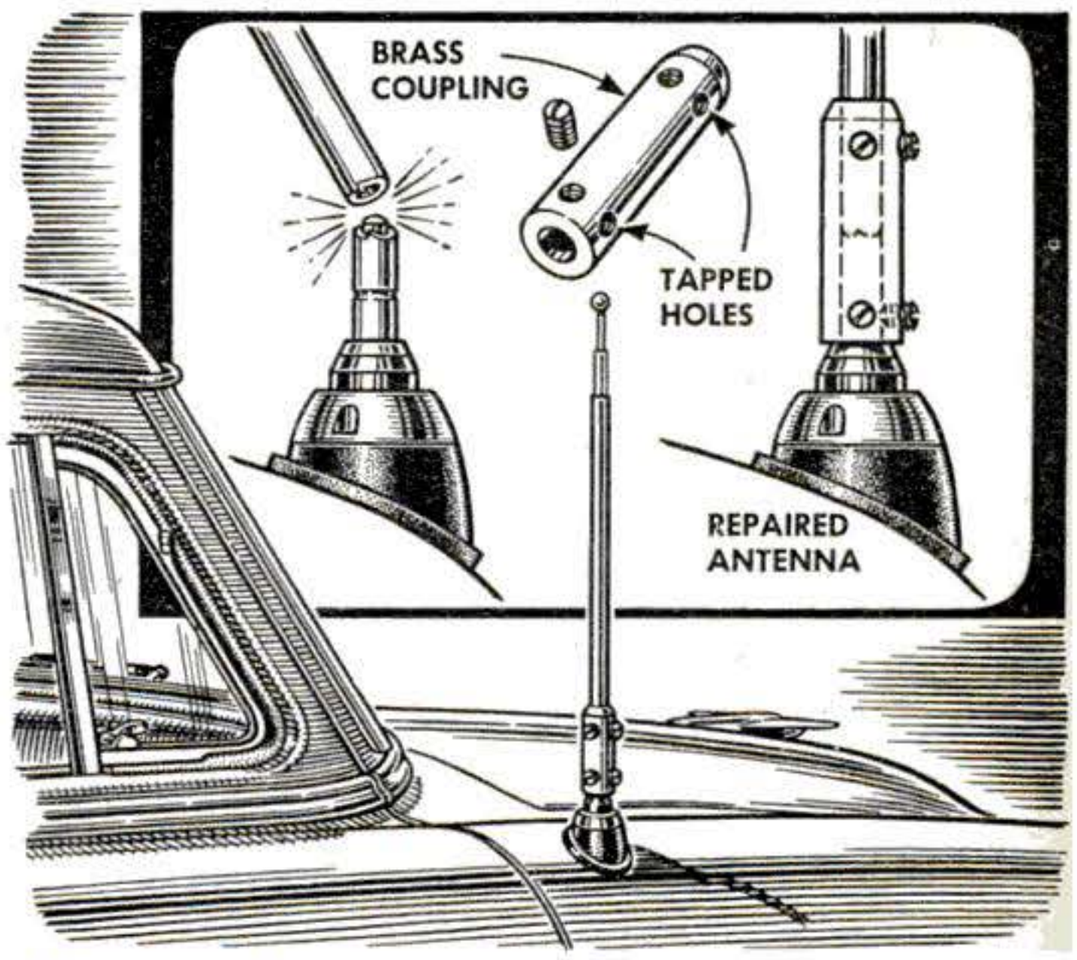
A small dent in the top of a car can often be pushed out by pressing a blunt ice pick or knitting needle through the headlining and tapping up. Then scratch the material around the hole in the headlining and fuzz it up to remove traces of the hole.



Because rubber grows in use, putting an old tube in a new tire may not be a good idea. New tubes usually are smaller in cross section than the same size casing to allow the tube to stretch into place inside the tire. An old tube may become pinched.



Rattle-free jack storage is easily provided. Attach two pipe straps to the trunk side with self-tapping screws, canting one in relation to the other so you'll have to press the wrench in place. Mount a spring to keep the jack butted against a wood block, with the shaft resting in a metal clip. Use the block as a wheel chock.



If an antenna is broken by mischievous children or overhanging tree limbs, it can sometimes be put back into service by making the repair illustrated here. The coupling might be made from a piece of brass, which makes a good electrical connection. Setscrews turned into the tapped holes will keep the two aerial sections together.

Please turn the page for more auto hints.

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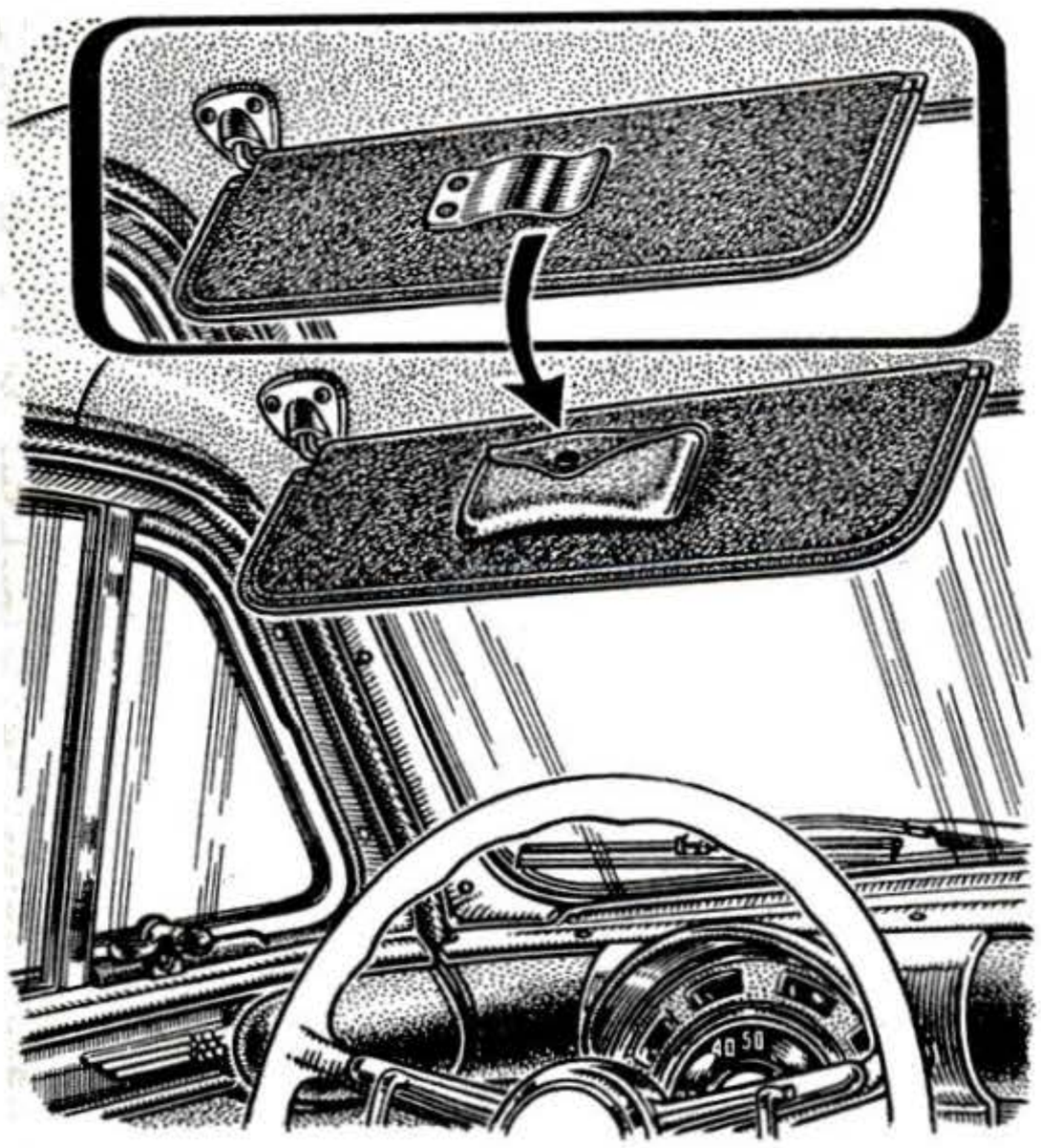
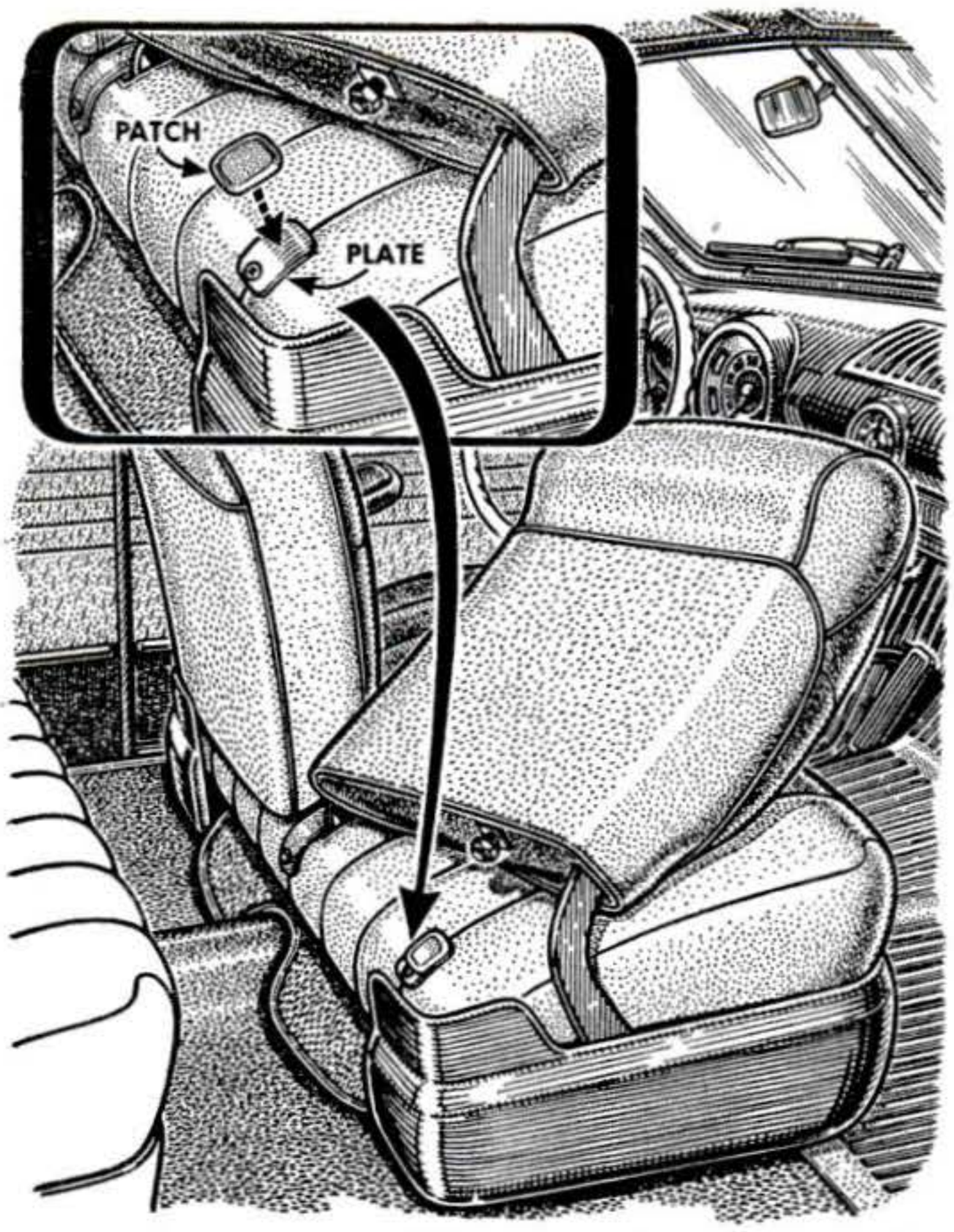
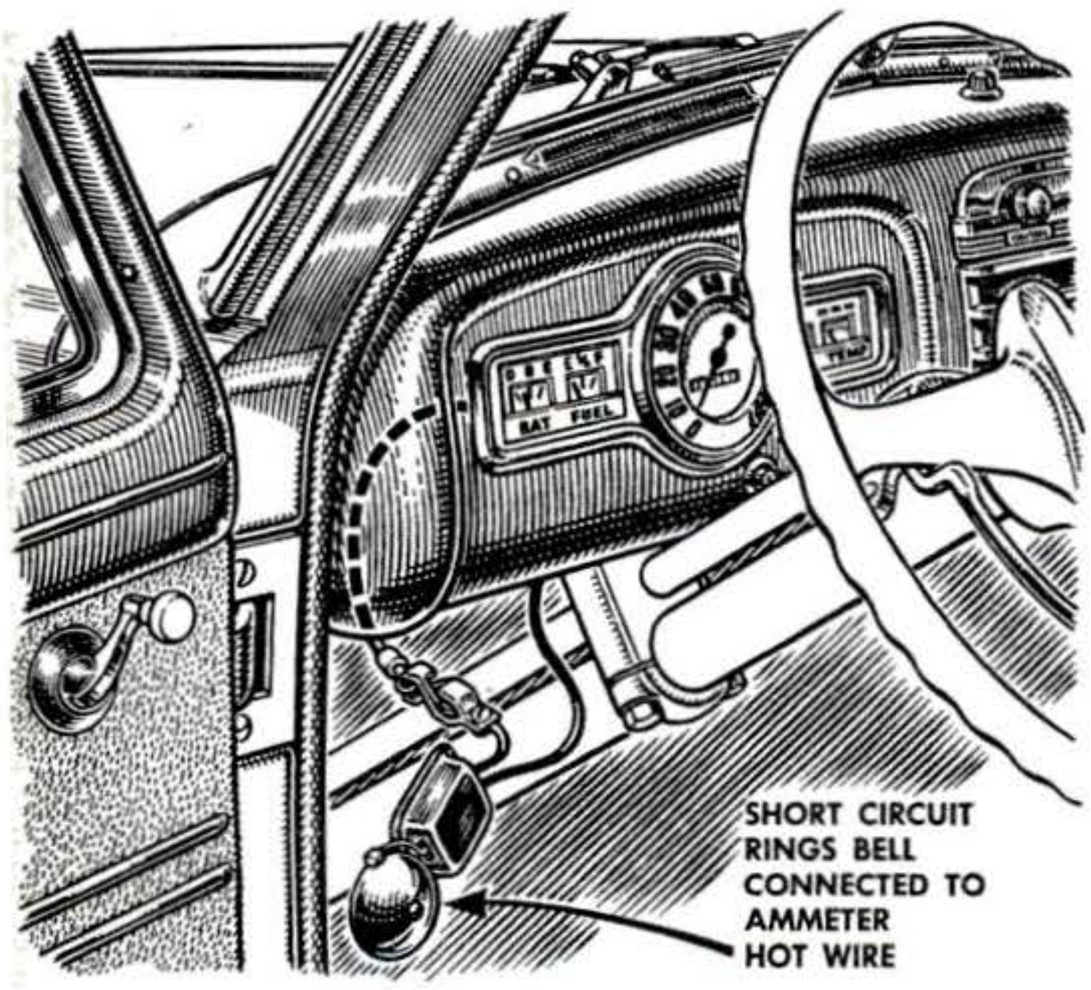
MORE Hints from the Model Garage



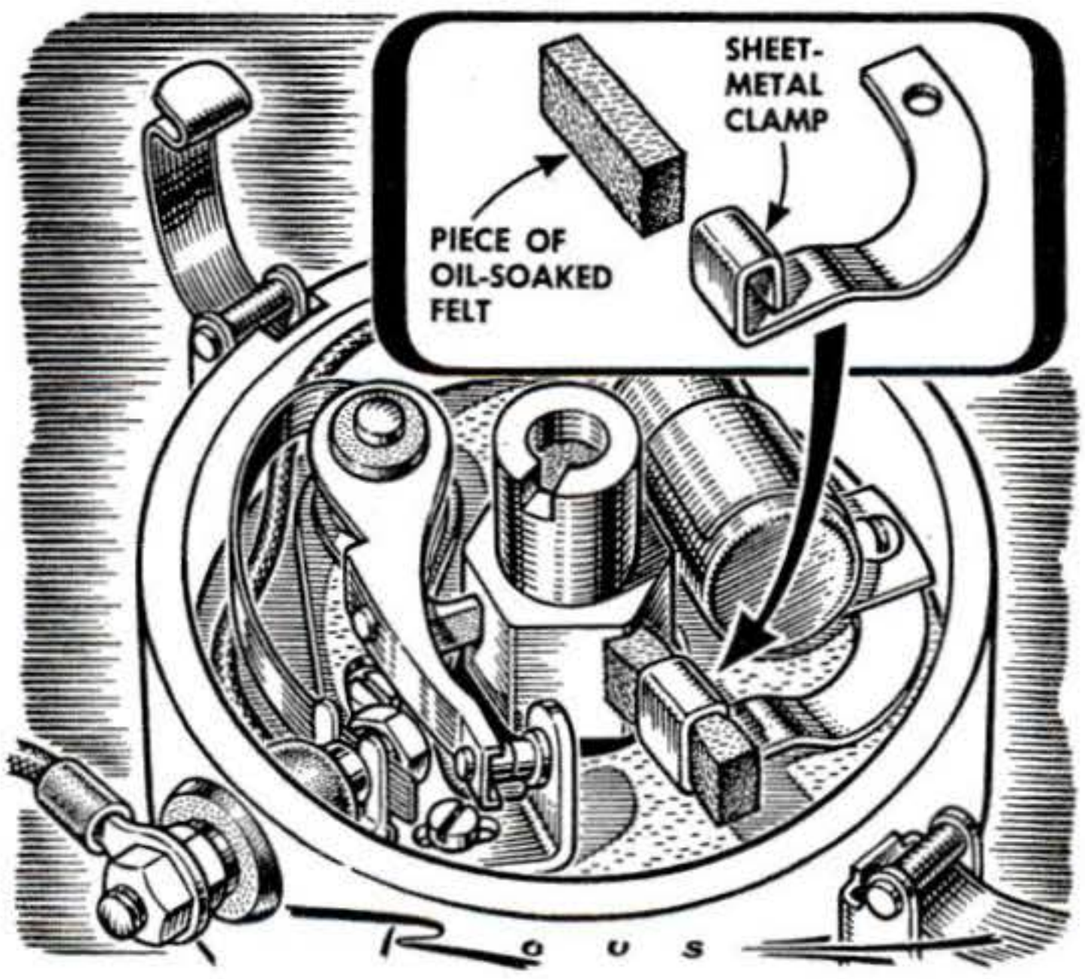
A rectangular piece of metal with one end screwed to the sunshield makes a handy clip for your sunglasses. Just slip the case on the clip. Sheet brass or aluminum might be used for the clip. Polished with steel wool, either metal will look good.



An annoying rattle may develop in the passenger seat of late-model Fords which have a small metal plate and limit bolt as shown here. The rattle usually can be eliminated by applying a ready-cut tire patch to the metal to act as a cushion.



A short in the wiring of an old car is sometimes difficult to hunt down because it is intermittent and unpredictable. If that happens to you, try connecting a doorbell in series with the hot lead to the ammeter and systematically bouncing on the bumper and wiggling the wiring until the sound of the bell leads you to the short.



Ignition troubles are sometimes traced to rapid wear of the fiber rubbing block that actuates the ignition points in the distributor. This wear can be reduced by keeping the cam lubricated. A felt oiler held in a sheet-metal clamp is one way of doing this. Apply a drop or two of light oil to the felt.

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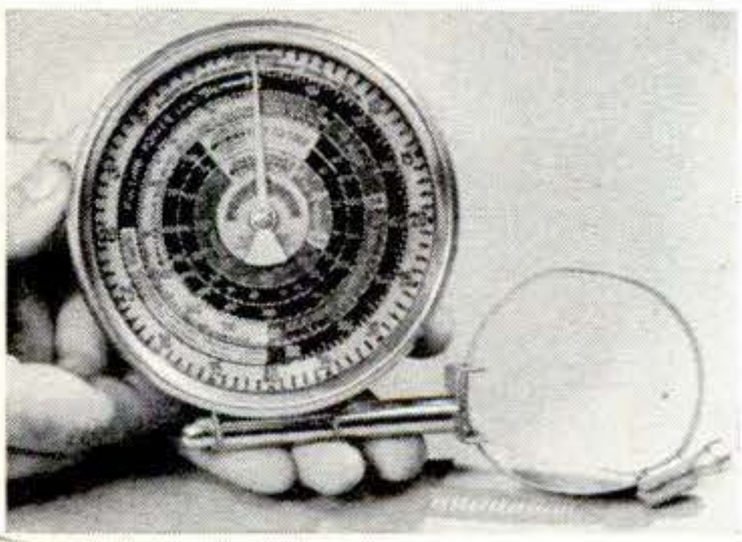
Gadgets for Your Car

Rubber Bumpers Prevent Door Scratches

BE A good neighbor on the parking lot by installing Dor-sav-rs. These will keep adjoining cars from being scratched or dented when your doors swing open. Made of stainless steel with rubber tips, the guards also help keep paint from being chipped off the edges of the doors of your own car. *Par-Style Products, Berkley, Mich.*

Meter Uses Pendulum Principle

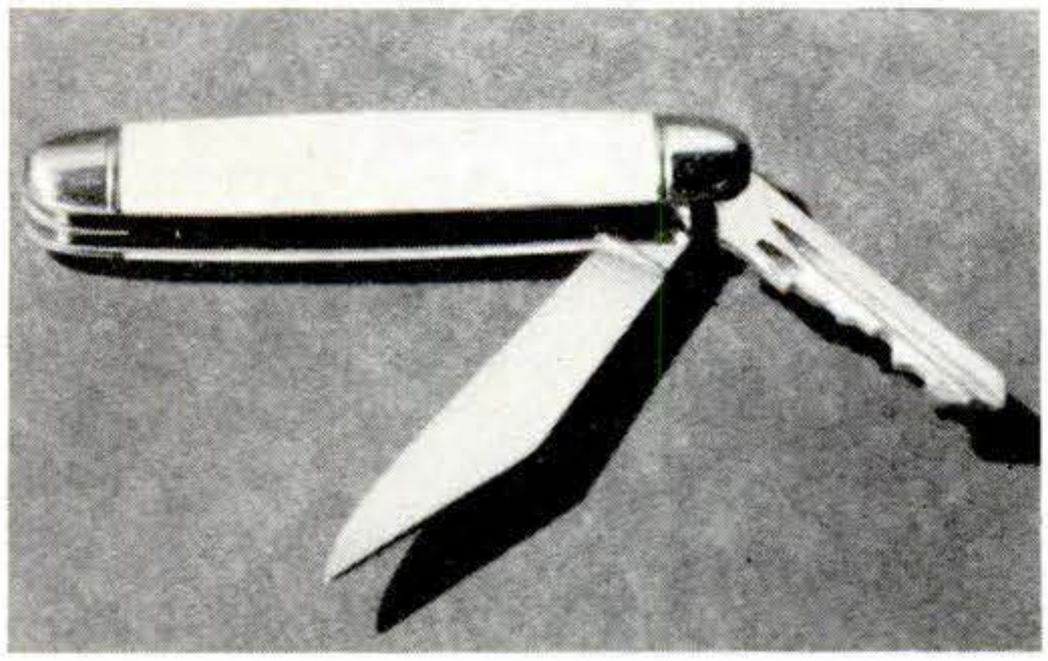


A NEW accessory, the PerfOMeter, utilizes an old principle of physics to tell you how your car is performing. A pendulum, suspended in oil to damp its action, swings back on accelerating; forward on braking. This action is transmitted to the accessory's indicator needle and interpreted by the dial. For use, the meter is clamped on the steering column or instrument panel. It is self-contained and is not connected to the car in any other way. *Autosphere Corp., 551 Fifth Ave., New York, N.Y.*

You Can Spot It Anywhere

AN INITIALED flag on your car aerial will enable you to spot your car at once in a crowd. The flag is made of aluminum in pennant style and will be stamped with your initials. *Cal-York Products Co., 909 Park Ave., Rochester 10, N.Y.*

Pocket Knife Has Spare Key



A SPARE ignition key can now be carried in a handsome pocket knife. A brass key blank furnished with the knife can be easily cut to fit any car. *Ross Associates, Box 3107, Baltimore 28, Md.*

New Breather Cleans Intake

HOT engines are claimed to start quicker with a breather on the intake manifold to clear out waste gases and allow the new fuel charge to reach the cylinders. The inch-long unit has a brass body, aluminum cooling head and stainless-steel ball valve. *Hellings Co., N. Hollywood, Calif.*

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We're Swimming in a

THE BIG MOMENT—wading in the family's new swimming pool as the first test water flows in. Gap in flagstones (background) was left for overflow so that water can carry off leaves and twigs that drop into the pool.

THE HOUR BUDGET

This includes the time—ours and that of friends—put in after the excavation was finished. No hired hands were used.

Placing drain and reinforcing steel: 2 men for 4 hours	8 man-hours
Mixing and placing concrete: 4 men for 15 hours	60 "
Hauling and setting flagstone: 2 men for 10 hours	20 "
Putting on white coat: 2 men for 8 hours	16 "
Sanding white coat: 2 men for 2 hours	4 "
Putting walkway along one edge: 2 men for 5 hours	10 "
	118 man-hours

THE DOLLAR BUDGET

1,000 sq. ft. of reinforcing mesh	$ 35.50
1,200′ of ⅜″ reinforcing rod	54.00
Drain and pipe	8.50
18 yards of sand and gravel	63.00
82 sacks of cement	95.12
16 gallons of Novamix, plus freight	31.11
4 sacks of white sand	3.60
2 sacks of white cement	8.60
Pickup load of sand for mortar	1.00
	$300.43

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Homemade Pool

By Paul Corey and Darrell Huff

Since we don't miss that expensive Hollywood-style treatment, we have just as much fun as in a professionally built job.

FINISHING the concrete pour on our home-built swimming pool, described in PSM last month, put us past the halfway mark of our construction job. But we knew we still had a pile of work between us and the first splash. For one thing, the whole interior of the pool had to be finished with a white coat of mortar. Before starting that, however, we had to install the coping around the edge so that there would be no danger of spoiling the white coat by spilling mortar on it.

Coping with the coping. Some kind of coping is a customary part of a pool but hardly essential. We added one for a trim appearance and also because it gave us a chance to level the pool top, make it several inches higher and, by providing an overhang, reduce loss of water from the splashing of swimmers.

We used something like a ton of flagstones that we were able to obtain free for the hauling. Brick is also sometimes used. So is cast-stone coping, which is the neatest of all, but enough to do our job would have cost just about as much as the whole pool did.

We laid our flags all around the pool except for skipping about 3′ for an overflow outlet to carry off some of the leaves and other floating material that is bound to fall into an outdoor pool. We set the flagstones in a bed of mortar (one shovel of cement to three of sand) and used the same mortar to fill between them. We kept them fairly level by sighting along our level-on-a-tripod but didn't take the time to try for a slick and professional job. We wanted something of the rugged look of a natural pond anyway.

We placed the flags to slope slightly away from the pool and let them overhang the inside by an inch or two. This gives something for a swimmer to take hold of and also cuts down splash.

The white coat. Traditional way to give a pool a smooth finish and make it more nearly watertight is to trowel on ¼″ of sand-and-cement mortar. Then, to get a pretty pool, you paint it.

The cheapest paint to use is ordinary Portland cement paint, which can go on right away. More costly but much more durable are rubber- or vinyl-base paints; these go on after the pool has cured for at least a month and then has been thoroughly dried.

The trouble with painting is that it leads to repainting. To get around this the pro-

ROUGH FLAGSTONES were set around the rim of the pool, both for looks and to keep down splash. As in the original survey, a homemade transit—carpenter's level on a camera tripod—was used to level the rim.

CORD connecting level points established by the transit kept the flags in line. Edge of pool concrete was wetted, sand-and-cement mortar put down, flags bedded and more mortar put between them to make an even paving.

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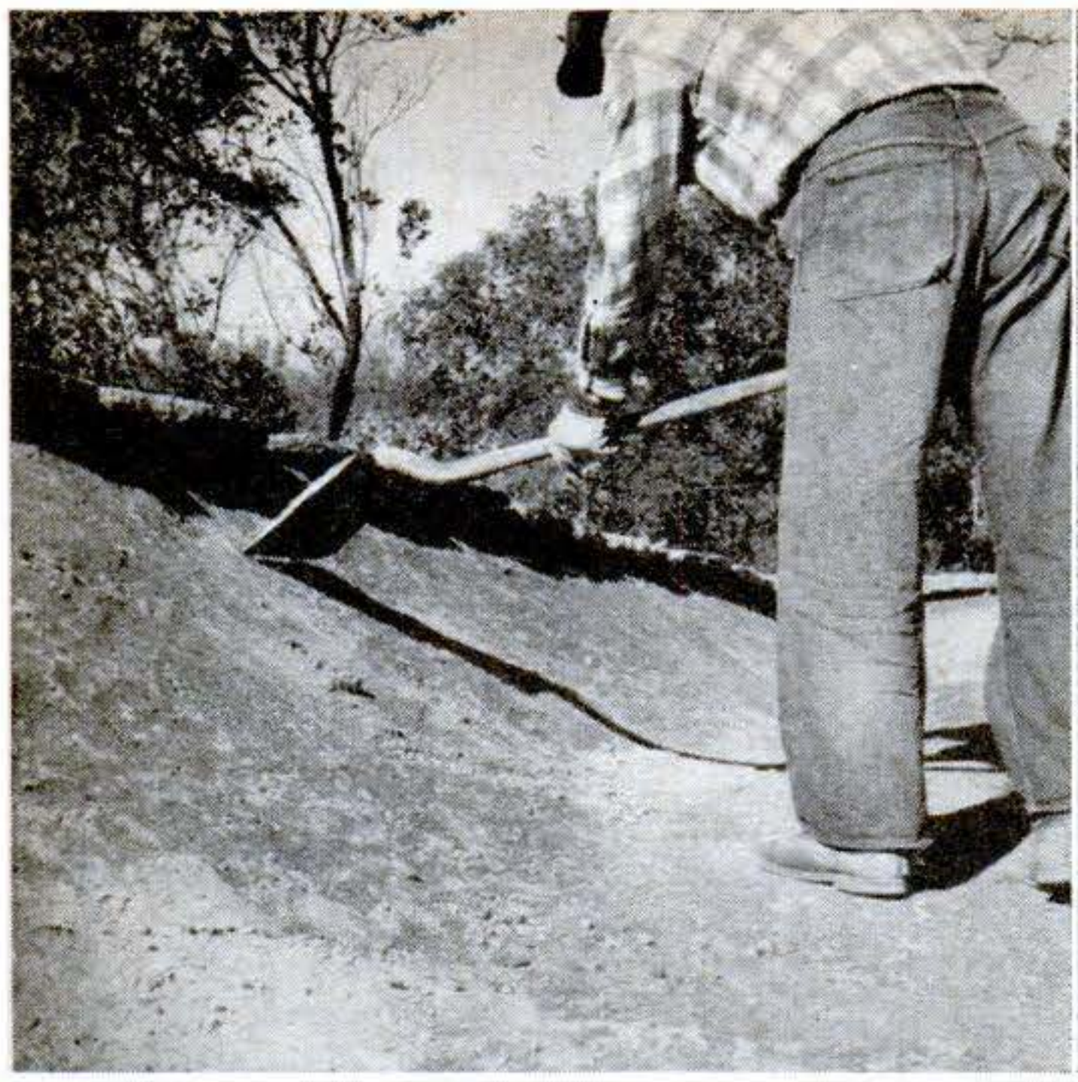

SCRAPING the rough coat of cement with a square-end shovel knocked off projecting gravel and mortar spilled during coping job, was essential in preparing for white sacking coat. Next, pool was swept clean with broom.

WHITE COAT was poured on the concrete base after it was thoroughly wet. Final coat was soupy mix of two parts white sand to one of white cement. Note roughness of base—authors say not to worry if yours is no worse.

fessional pool builders now favor a special white coat of which the basis is white sand and white cement. This is applied with a trowel and often is a two-coat job. Properly done you get a very smooth pool that is gleaming white and gives filtered water a turquoise color. However, we were told that using this material would make it necessary to hire a trained plasterer.

While tossing these alternatives around we were lucky enough to run into a fellow named Otto Burgmeier, who operates a swimming-pool maintenance-and-equipment service in our neighborhood. He told us a trick he had learned that sounded—and proved to be—ideal for amateur use. He called it sacking.

By the time we'd finished the coping job and rested our bones, the concrete had had several days in which to set. During that time we had kept the surface damp for better curing by sprinkling it with water frequently.

Sacking consists of applying a thin coat of mortar made by mixing one part of white cement to two parts of white sand and adding enough water to make a heavy paste. We used four sacks of sand and two of cement. These white materials are not hard to find since they are commonly used in laying glass block.

We applied the white coat by dumping a shovelful of the pasty mixture onto the dampened surface of the concrete and spreading it around with a pad of burlap. Then we rubbed the stuff in vigorously to fill all hollows and rough spots.

The burlap wears out quickly and must be replaced, so be sure to have a couple of clean gunny sacks on hand when you start the job.

Otto told us to go back over our job after a little while and rub off the rough spots, but we didn't get a chance to do that. Instead we sandpapered it the next day. We simply rolled up a couple of belts discarded from our belt sander and gave the whole surface a quick rubdown. The result is a nonskid finish that seems to be working out very well.

Sidewalk. Some kind of walkway around a pool is pretty nearly essential, and we put in the easiest kind. (You're going to suspect that we do everything the lazy way, and you're going to be right.) We simply cut out earth for about three feet from the flagstones and filled the cut with concrete two or three inches thick. To prevent rain water and dirt from running into the pool, we made sure to slope the walkway away from it.

We troweled the sidewalk surface reasonably smooth and, after a couple of hours, dragged a broom across it a few times to produce an attractive nonslip surface.

While we were about it, we hollowed out a spot in the earth at the shallow end of the pool and plastered it over with concrete to

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GUNNY SACKING was used to spread the white coat evenly, forcing it into holes and rough spots of the undercoat. If you value your hide, wear gloves—authors found the heavy rubber kind the best.

SACKING HALF DONE, here's how the pool looked. Sacking method gave good results and required less skill than usual troweling. It also used less of the expensive white sand and white cement.

form a tiny foot bath. A foot of 1″ pipe with an ell on it forms a drain in the bottom. The water can be changed as often as necessary, or even flow through continuously when the pool is in heavy use. We figure the foot bath will cut down the amount of sand and soil tracked into the pool.

Philip Ilsley, president of the big pool-building Paddock Engineering Company, had advised us to give the concrete from three days to a week to gain strength before putting the weight of water on it. We came close to the latter figure for safety, meanwhile keeping the pool damp as much as possible for better curing. Then we began to fill the pool—a great day, you can take it from us. Once we started we kept the water flowing continuously until the pool had reached its capacity.

What about a filter? We don't have a filter system for just one reason: approximately $750. For the present, we are satisfied to operate our pool on a fill-and-draw basis.

To use the fill-and-draw method you must, however, have some way to dispose of the water when it gets dirty; preferably you should have a use for the water. We simply gravity-drain ours and use it for irrigation.

We accept the fact that a filter system is worth the cost and probably is, over the years, the only feasible way to operate a pool and get full and easy use of it. Lacking that $750, we plan to get to work shortly

SANDPAPER—a medium belt discarded from a belt sander—smoothed the final surface. Authors say they should have given the white coat a second going-over few hours after it was put on to make surface even smoother.

WALKWAY, about 4′ wide, was set in behind the flagstone coping. The bank was cut back and served as the outside form, while flags were the inner form. Walkway slopes away from the pool to carry off rain water.

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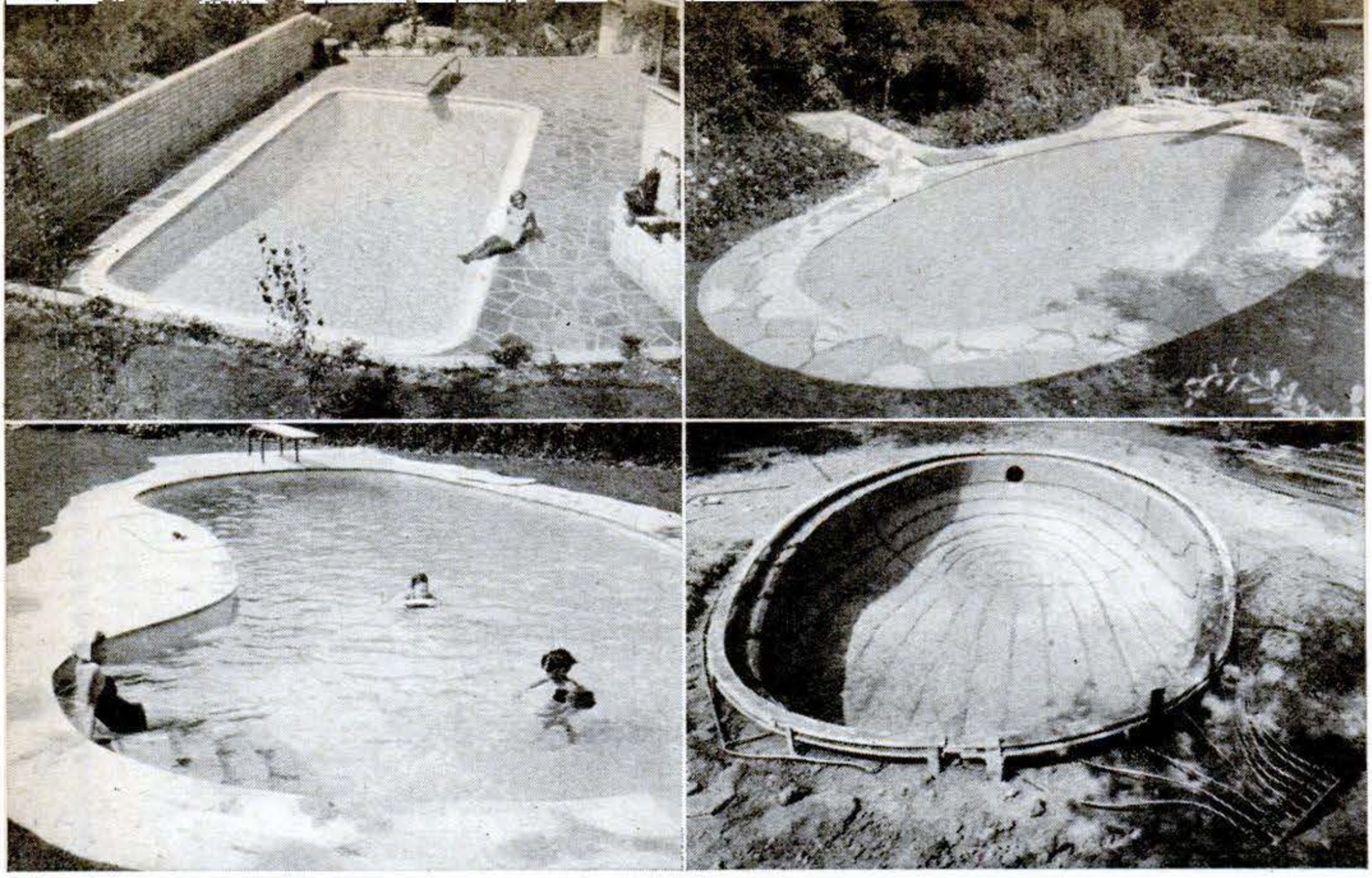


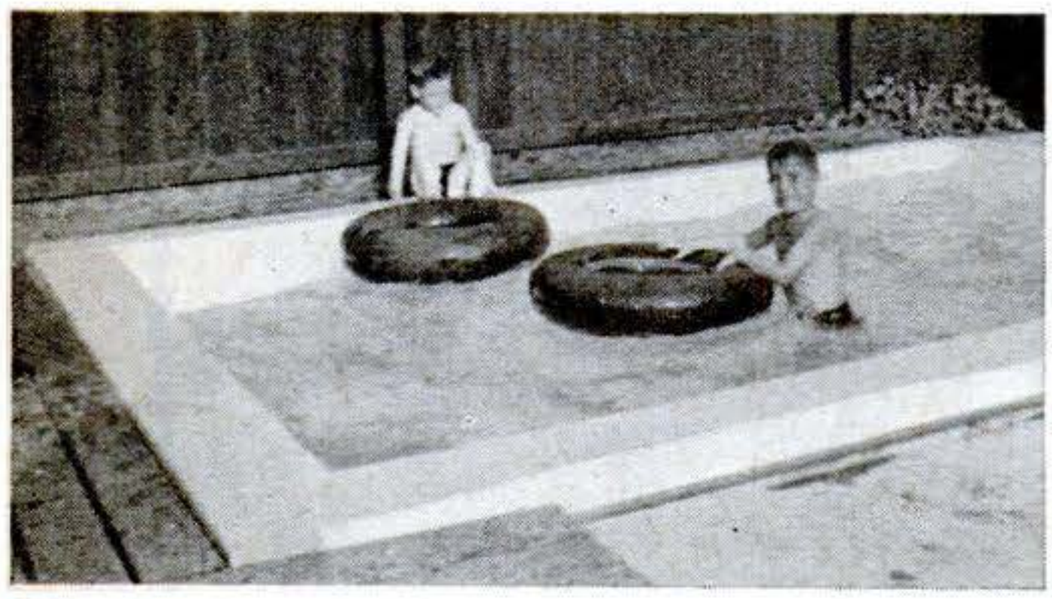
PRETTY—BUT EXPENSIVE—these professionally built pools can give the amateur some good design ideas. Rectangular pool, top left, shows the most common shape, has vertical sides needed for diving. Heart shape of the pool below it is easier for the amateur to build, as well as being often more attractive. Oval pool, top right, fits particularly well into formal garden setting. Ultimate luxury is a heated pool like the half-built one shown at lower right—but it's no job for an amateur. Heating pipes must now be covered with reinforcement and Gunite concrete, which has to be hosed on under pressure. It costs about as much money to heat a pool as it does to heat a house.

and see if we can build one. We think a big box full of sand and gravel put down in layers, along with a pump and motor and some pipe and valves will do the trick. We have a hunch that a couple of old washing machines will provide most of the parts we need. But in the meantime we're mighty happy with our home-built swimming pool —and so are all the kids in the neighborhood. END

The Kids Can't Crack Our Glass Swimming Pool

I'M NO goldfish, but every day I go swimming in a glass pool. What's more, I built it myself in the yard with the gleeful help of my seven-year-old son and his friends. But the pool is made of the glass that goes into armor-tough auto bodies, not aquariums —glass-fiber cloth, impregnated with a plastic resin.

We started by building an 8′ by 12′ wooden coaming—like a huge picture frame. This we laid on the ground at the site. Then we dug out 30″ of dirt right up flush to the inner edge of the frame, leaving smooth vertical walls and flat bottom. I laid three layers of asphalt building paper on the bottom and one on the sides. Finally, we covered bottom, sides, and coaming with glass cloth and plastic. The heavy soil holds the sides with no other support.



We fill the pool with a garden hose, using house water run through a homemade filter. A small power pump empties it and the water goes to the garden. A tiny dose of copper sulphate keeps the pool free from algae, and for sanitation we add chlorine bleaching fluid each day that we decide to use the pool.

When the pool is not in use we cover it with a couple of plastic dropcloths sewed together. This keeps out dirt and stray animals.—*H. E. Biggs, San Leandro, Calif.*

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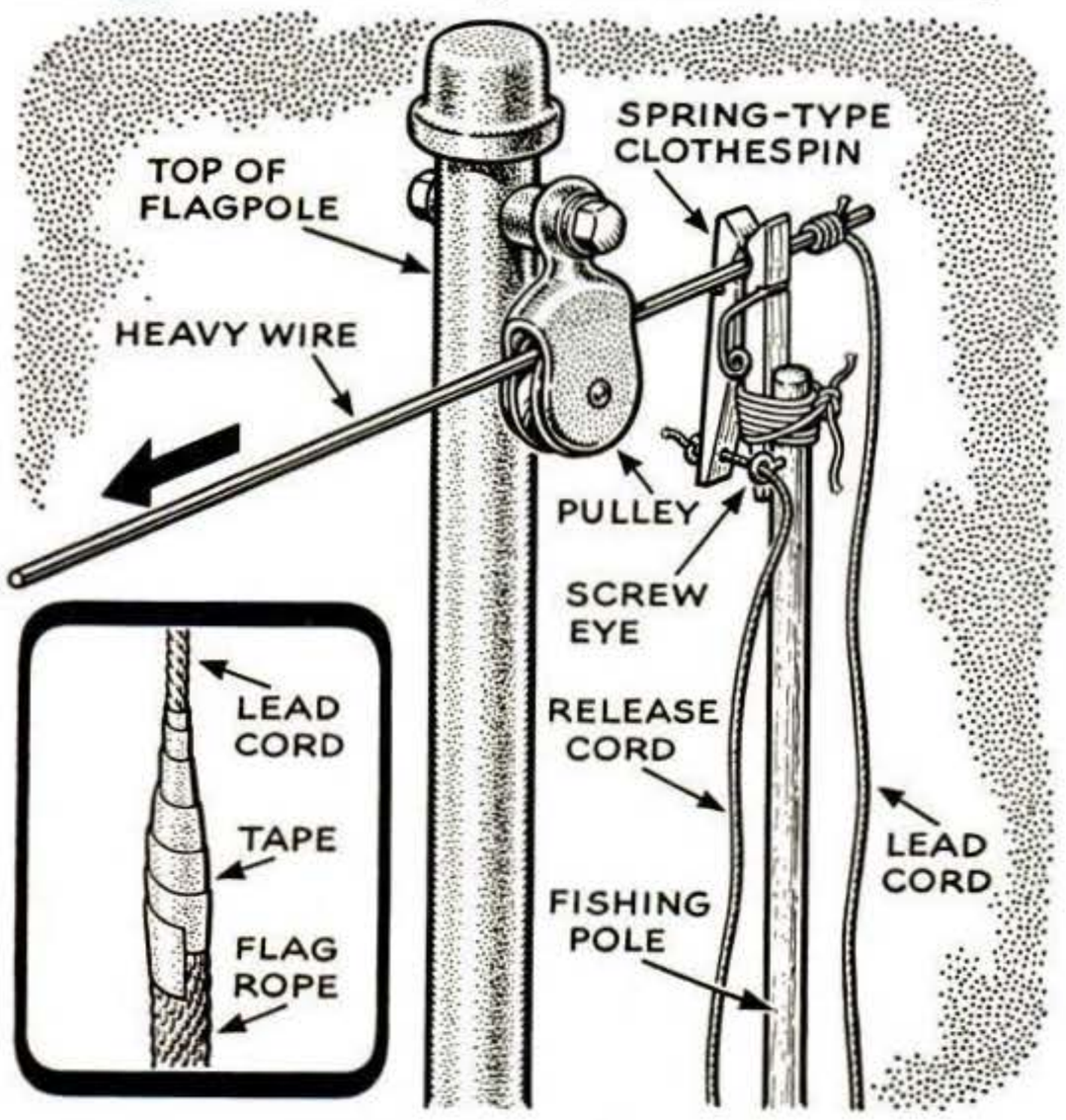
Kit Improves Phonograph

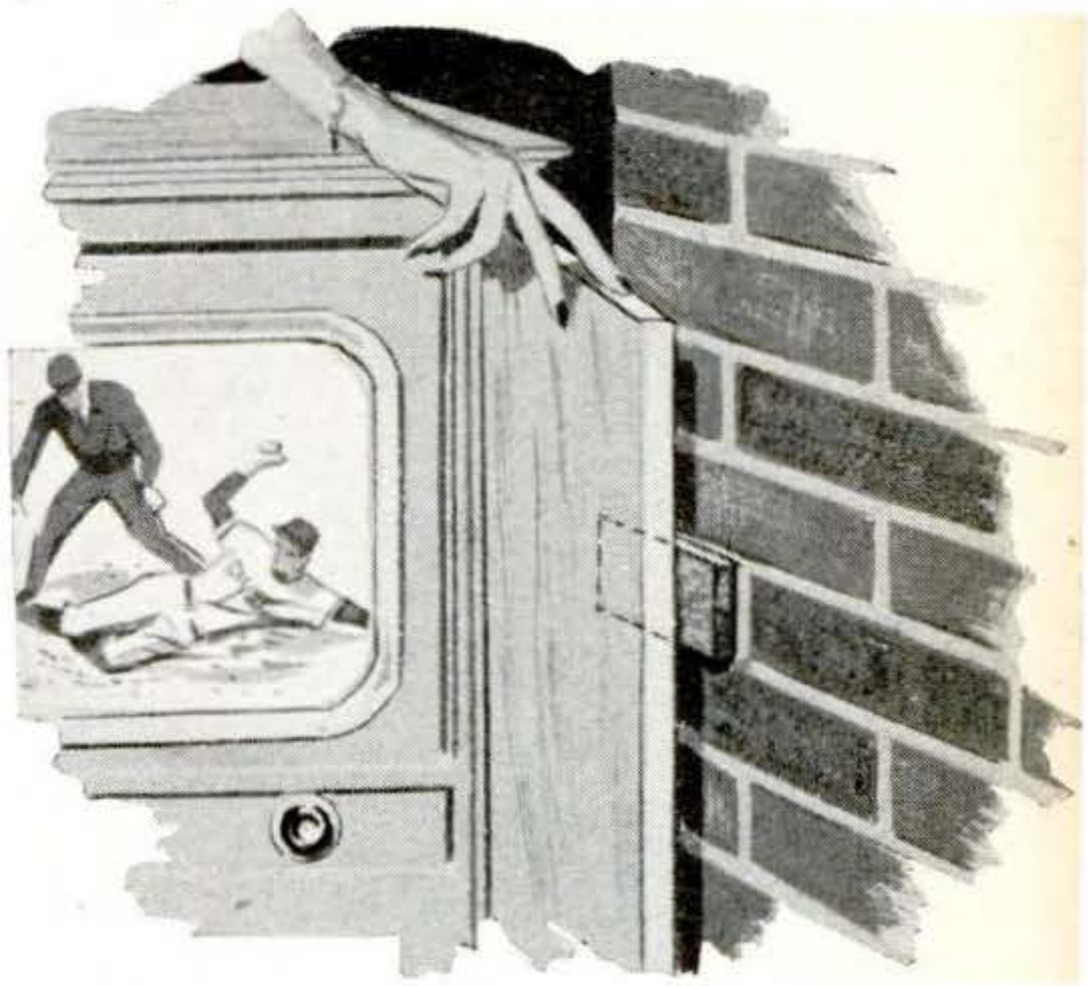
You can modernize your record player with this high-fidelity kit designed for easy hookup to any phonograph. The kit includes two pickup cartridges, for regular and slow-speed records, preamplifier and adapter head. Instead of generating its own current, the pickup has a steady current fed to it from the preamplifier. This is said to permit the needle, relieved of being its own generator, to follow the record grooves more faithfully. *Pfanstiehl Chemical Co., 104 Lake View Ave., Waukegan, Ill.*

Flagpole Pulley Threads Easily



You can start a rope through a flagpole pulley without climbing to the top of the pole if you use this method. Use the setup shown in the sketch above. After the heavy wire is pushed through the pulley, pull the release cord to open the clothespin. The wire will drop, pulling the lead cord through the pulley. Then tie the flag rope to the lead cord and pull it through. If the rope doesn't slip easily into the pulley, taper the spot where cord and rope join with tape, as shown in the inset.—*Henry S. Rorer, Norfolk, Va.*

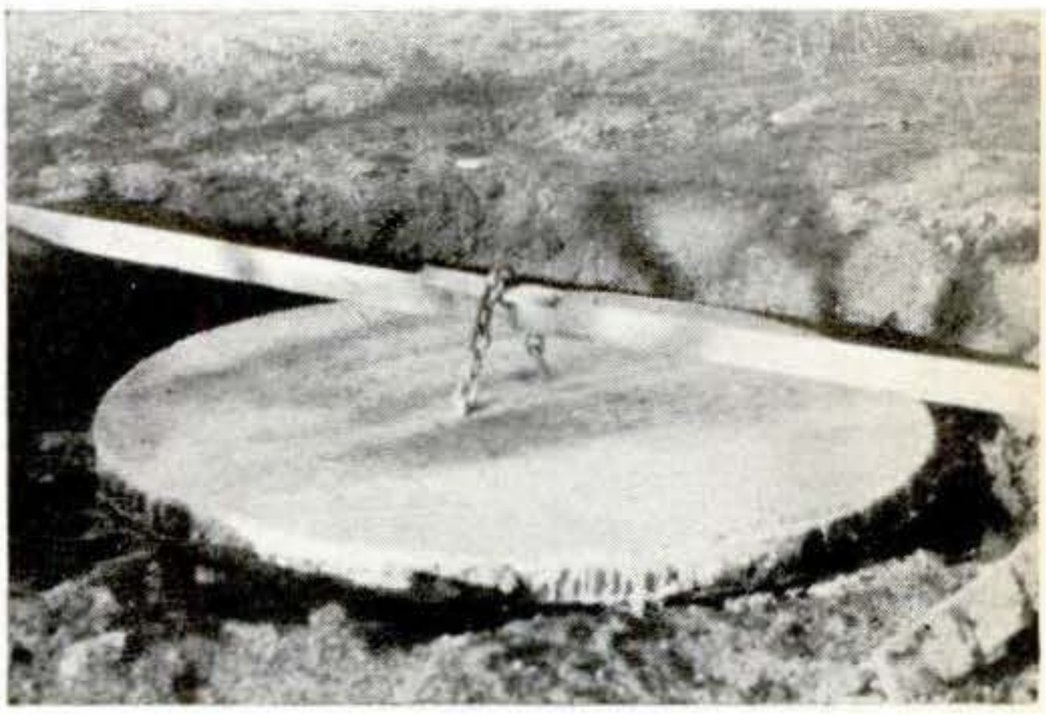
Bumper Protects TV Door



When the door of our TV set is open, it sometimes touches the rough brick of the fireplace. To protect the door's finish, I cut a section from a red rubber car-washing sponge and pasted it over one of the bricks with rubber cement. The bumper is inconspicuous and keeps the door from being scratched—*J. G. Voelker, Baltimore.*

Wheel Makes Cover for Dry Well

Needing a new cover for my dry well, I used the wheel of an old hay rake as both the reinforcing and the form for the concrete. Sheet metal was wired to one side of the wheel and a length of chain was looped through the spokes. Then the wheel was laid over the well, sheet-metal side down, and the concrete poured. The chain will serve as a handle if I ever want to remove the cover.—*T. H. Lavengood, South Bend, Ind.*



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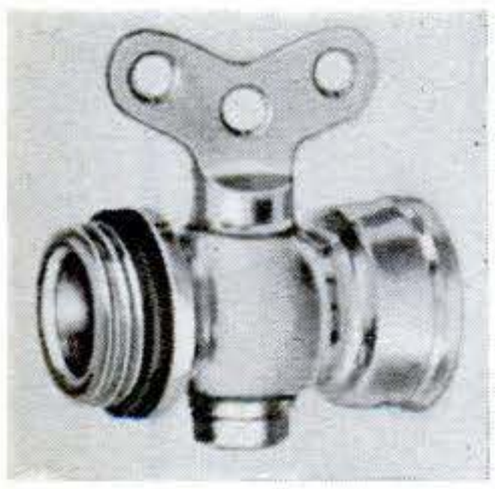
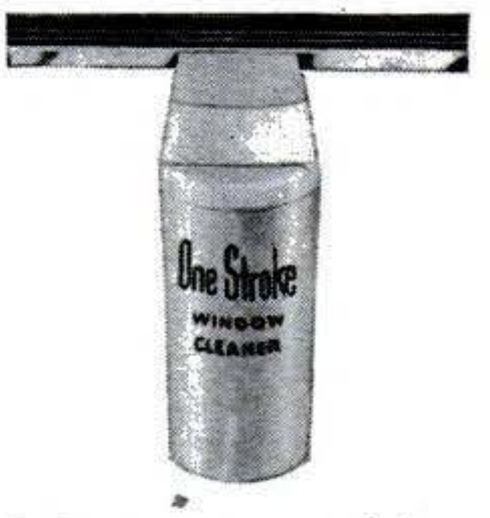
New for the Handy Man

1. Tiny Pump Drains Cellar. You use water to get rid of water in this inexpensive pump for draining flooded cellars. Connected to a faucet by a short length of garden hose, Drainmaster uses the pressure of water flowing through it to pick up additional water from the cellar floor, carrying it down a drain or out a window through another hose. It will lift water about 6′ and handles 300 gallons an hour.



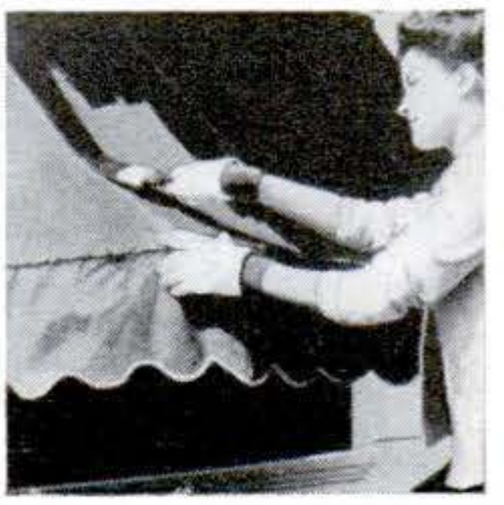
2. Valve Shuts Off Hose. Hook this valve to your garden hose and you can turn the water on or off from any point in the yard without going back to the house faucet. It fits all standard hose couplings and can be connected between the nozzle and the hose or between any two hose sections.



3. Squeegee Holds Cleaner. Just fill the hollow handle of this squeegee with detergent and you can wash a window with one swipe. Squeezing the flexible plastic handle sprays out the detergent through tiny holes in the rubber blade, and the squeegee wipes the window clean.

4. Rubber Cushions Cabinet Catch. Cupboard doors close silently and stay tightly shut with this new latch. A metal plunger on the door slips into a neoprene-rubber cylinder on the cabinet. The neoprene grips the plunger firmly, keeping the door from bouncing, banging or springing open.

5. Paint Weatherproofs Canvas. Awnings, lawn furniture, beach umbrellas and other canvas articles that have become faded and leaky can be restored with this special paint called Setfast. It provides a tough, weatherproof finish, is flexible to prevent cracking and comes in a variety of colors.



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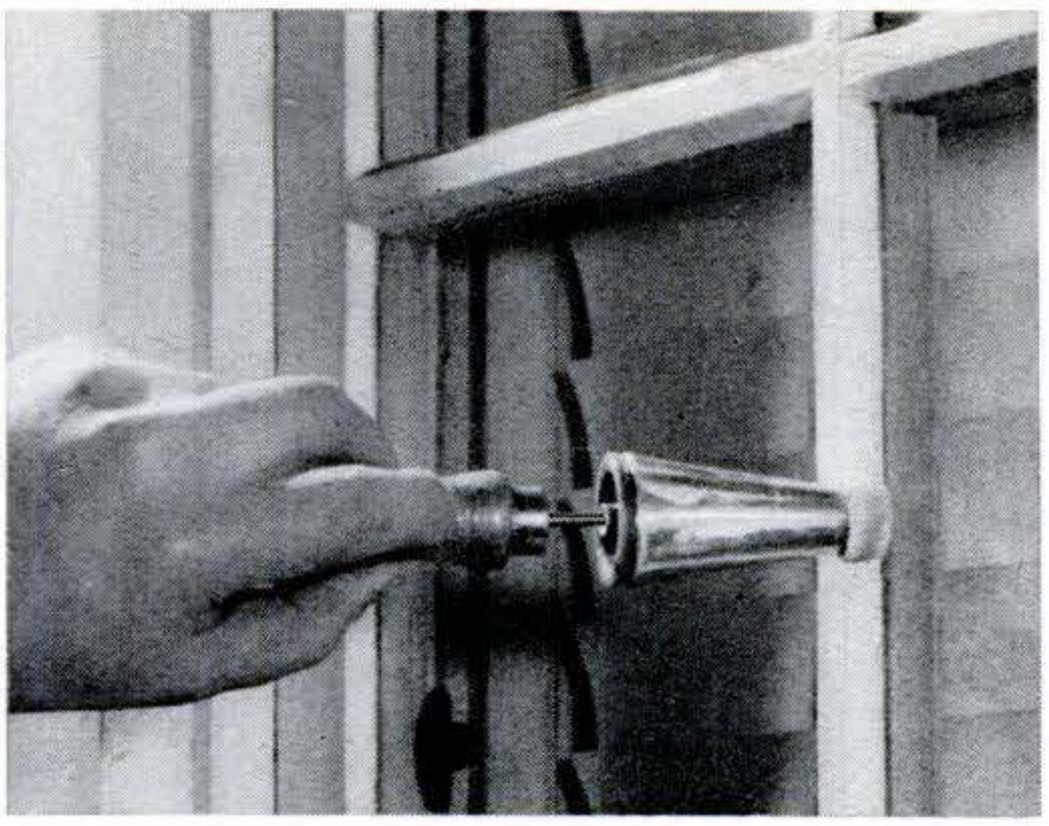
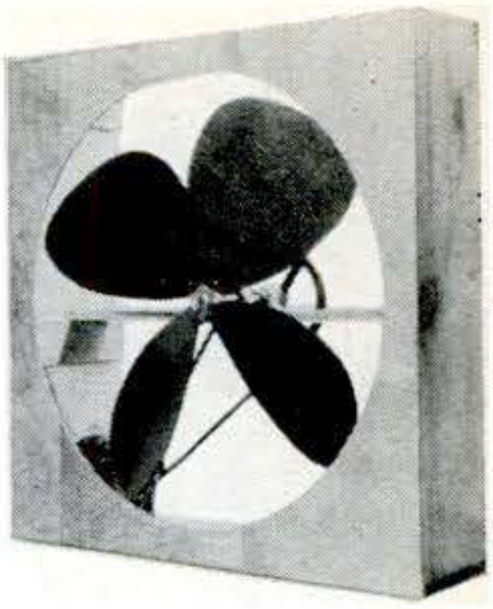
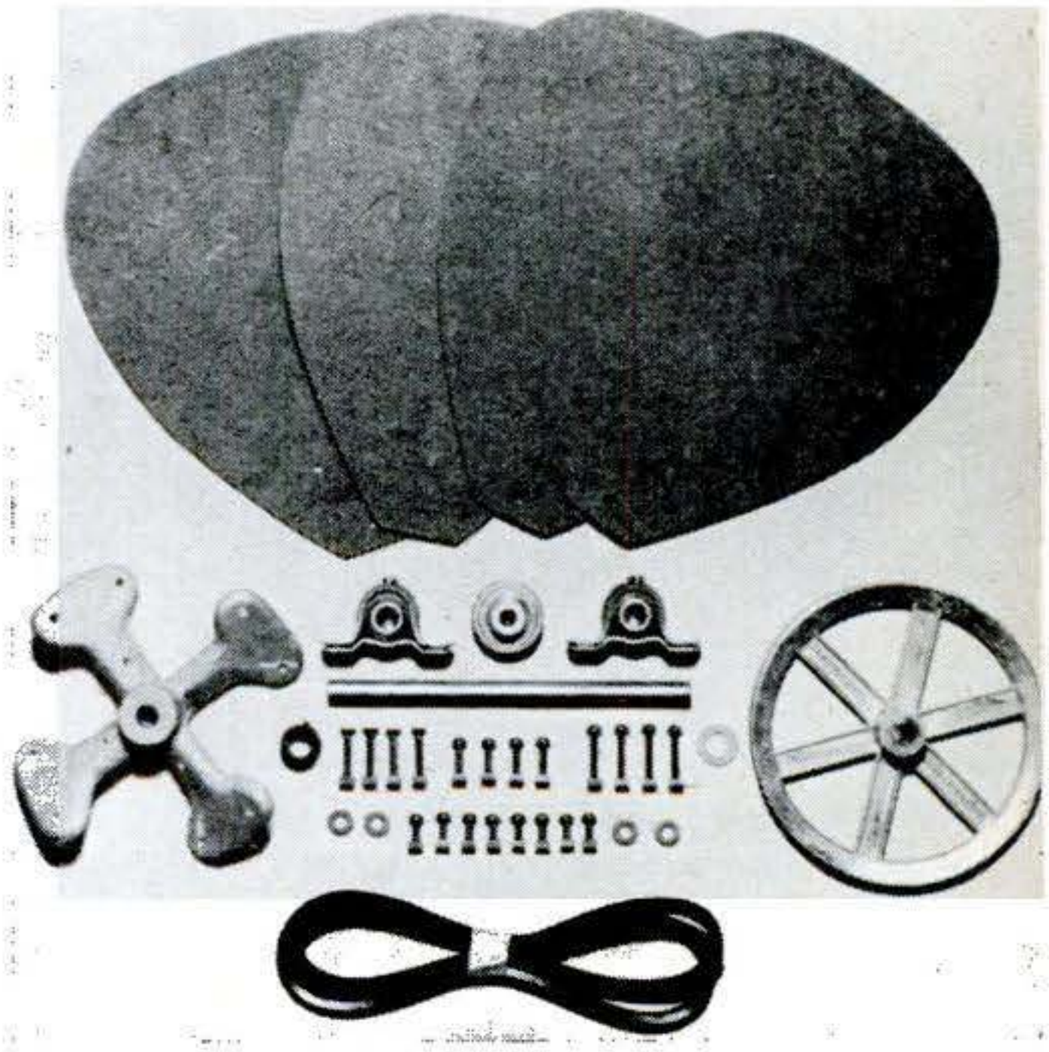


6. Roller Paints Window Sash. You get paint on the sash and not on the glass with this small window roller. Paint is poured into the metal cone and seeps out gradually through a felt pad as it is rolled along. A metal disk at the tip rides against the windowpane to keep paint off the glass.

7. Tray Pastes Wallpaper. No more measuring, cutting and messy pasting of wallpaper, say the makers of this pasting tray. Just fill the tray with paste and plop in a roll of paper. As you pull up each length, it comes out pasted, ready for hanging on the wall. It's then cut off at the bottom and the next strip pulled out in the same way. The Paperhanger is also said to eliminate tearing, folding and overpasting.



8. Kit Builds Fan. Everything needed to build a 30″ home exhaust fan except the motor is included in this inexpensive kit. It contains four paddle-like fiberboard blades that bolt to a special hub, two pulley wheels, bearings, belt and hardware. Any 1,725-r.p.m., ¼- or ⅓-hp. motor will drive the fan, and faster motors can be geared down. The fan can be placed in a window or attic opening and is said to move 5,600 cubic feet of air a minute.



9. Cleaner Scrapes Paintbrushes. A metal screen in the bottom of this can of brush cleaner lets you scrape the paint off bristles as it's loosened by the cleaning fluid. The raised screen permits the old paint to settle to the bottom, away from the brush, and also forms a platform to hold soaking brushes in the fluid. The Paint-Trap cleaner comes in quarts and gallons and can be re-used many times.

Further information on these products can be obtained from: 1. Burson Laboratories, 951 Willard Court, Chicago 22; 2. Melaire Distributing Co., 420 Lexington Ave., NYC 17; 3. Hall's Gift Shop, 127 So. Dubuque, Iowa City, Iowa; 4. Laboratory Equipment Corp., St. Joseph, Mich.; 5. Interchemical Corp., 224 McWhorter St., Newark, N.J.; 6. Strader Products Co., 259 Strader Ave., Cincinnati 26; 7. Hastings Products, 141 Fifth Ave., NYC 10; 8. Fan Kit Co., P.O. Box 5842, Memphis 4, Tenn.; 9. Klean Strip Co., P.O. Box 3565, Memphis 6, Tenn

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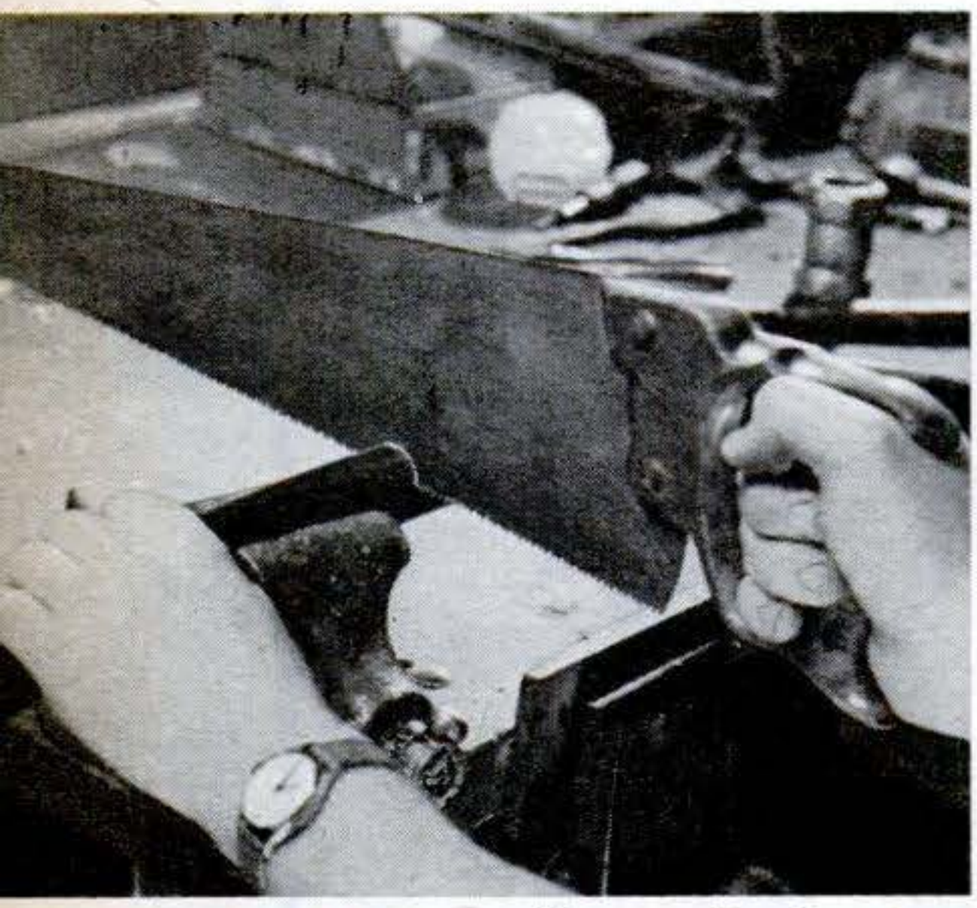
Plastic Pipe Makes Anyone a Plumber

So light that even the youngsters can tote it around, this flexible material will not break your bank either.

By E. F. Lindsley



SAW OR KNIFE will cut plastic pipe. No need for a special tool, and no reaming is needed after the cut.

IT BENDS EASILY. One of the conveniences of plastic pipe is the ease of assembling complex hookups. The writer eventually clamped this assembly to ceiling of home darkroom.

HOME plumbing jobs have always required a bit of know-how, and always will, but flexible plastic pipe makes them a lot easier. If you have a big plumbing job coming up, you may save time and money in large chunks by using this tough light-weight material.

With it, you can drop a jet-well hookup down the casing and be pumping water before the hoisting rig needed for metal pipe could even be set in place. If you have dreamed of an underground lawn-sprinkler system, plastic pipe is just the ticket. No need to worry about freezing, for ice just stretches the pipe a bit.

For the man who wants to tie a new outdoor hose connection, a home darkroom or a water softener into the house cold-water system, plastic pipe beats the problem of pipe cutters and threading tools needed to dodge metal pipe around basement obstructions. It bends easily around curves, and any saw or sharp knife will cut it.

What is it? Technically, plastic pipe is extruded polyethylene. It weighs about an eighth of its equivalent metal pipe, comes in standard pipe dimensions in coils containing up to 400 unbroken feet, and is absolutely inert with respect to drinking water and a long list of solutions and chemicals.

For the home user, the last point means no "pipe" taste in the water, and, even more important, no expensive replacement jobs every few years. With plastic pipe, rust, scale and electrolytic corrosion just don't enter the picture. Connections, either into conventional metal pipe or plastic-to-plastic, are made with molded hard-plastic fittings that are forced into the ends of the pipe and held permanently by stainless-steel clamps. Plastic to metal fittings

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SPECIAL FITTINGS are made of rigid plastic. Stainless-steel clamps draw plastic pipe down on serrated ends of fittings, making leak-proof connections. Fittings with threaded ends permit connections to standard pipe fittings. Other fittings include reducers and plugs, all matched to standard pipe threads.

have standard pipe threads on one end for ease in making the joint.

Not for hot water. Plastic pipe at present can't be used for steam lines, or where water temperatures may exceed 160° F. This usually rules it out for domestic hot-water lines, unless it can be made certain that the water heater will never deliver temperatures above this point. And while automatic water heaters are often set at 135° or 140°, the below-160° restriction could be a handicap with future dish- and clothes-washers, which sometimes require very hot water.

Since plastic pipe suffers some ill effects from prolonged exposure to direct sunlight, it should be covered at least lightly when installed outdoors. It does not deteriorate underground.

Although the pipe will merely expand when water freezes inside it, alternate freezing and thawing eventually may burst it. Plastic pipe, incidentally, can't be thawed by an arc welder since it is not a conductor. Its insulating properties are so good, in fact, that some utility companies use it to shield men working among 4,800-volt high lines.

Will it do your job? Answering this won't take much head scratching. Tests have shown that bursting pressures range from 540 lb. per square inch for ½″ pipe to 200 lb. for 1¼″ pipe, about as small and as large as pipe comes in most houses. Normal city or well-pump pressures don't come anywhere near these values. Since the stuff stays flexible to minus 40° F. and lower, you haven't any worries on that score. Laboratory tests indicate a working life of easily 30 years.

How much? Plastic pipe costs less than copper tubing, about the same as galvanized metal, and if its flexibility and easy go-together permit you to do the job yourself, you'll beat the cost of that much professional cutting, reaming, threading, and wrench pulling.

Even though it isn't recommended for hot-water systems, plastic pipe has been found to be just the thing for radiant heating because it is jointless and

HOME APPLIANCES like this water softener can be hooked up in minutes with plastic pipe. Persons living in rented property and owning the appliances can therefore move them.

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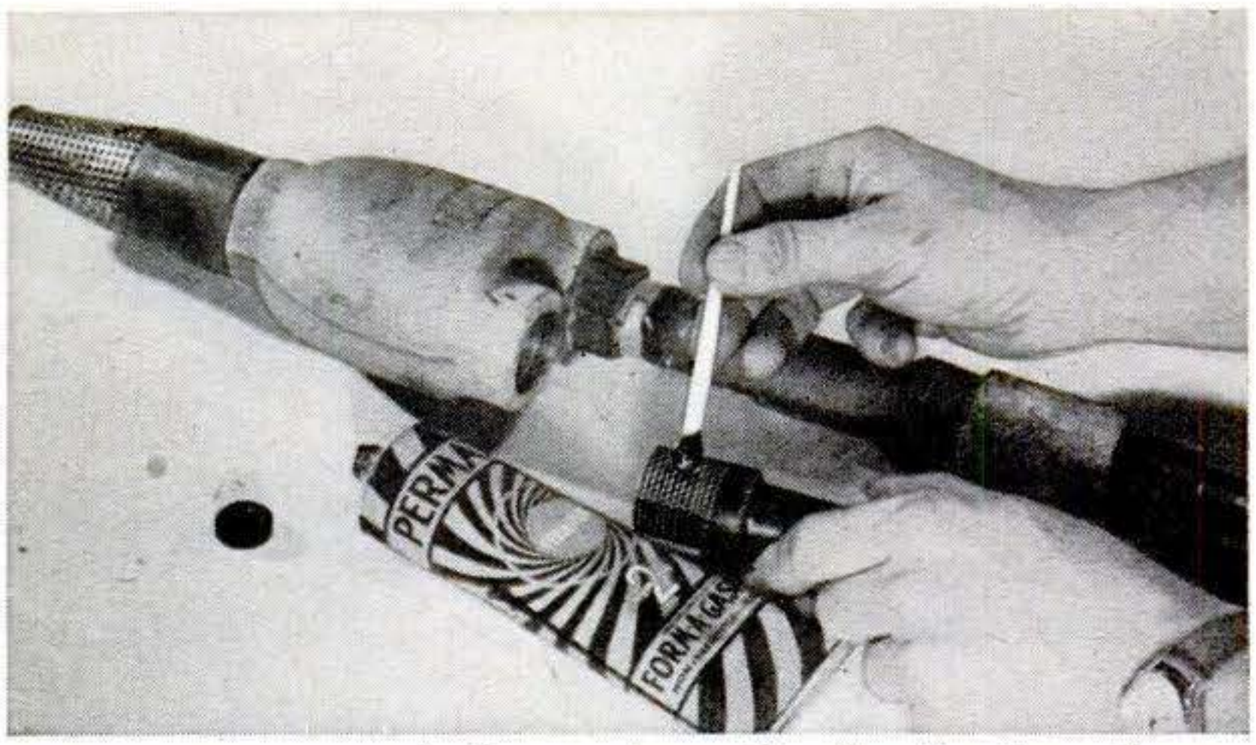


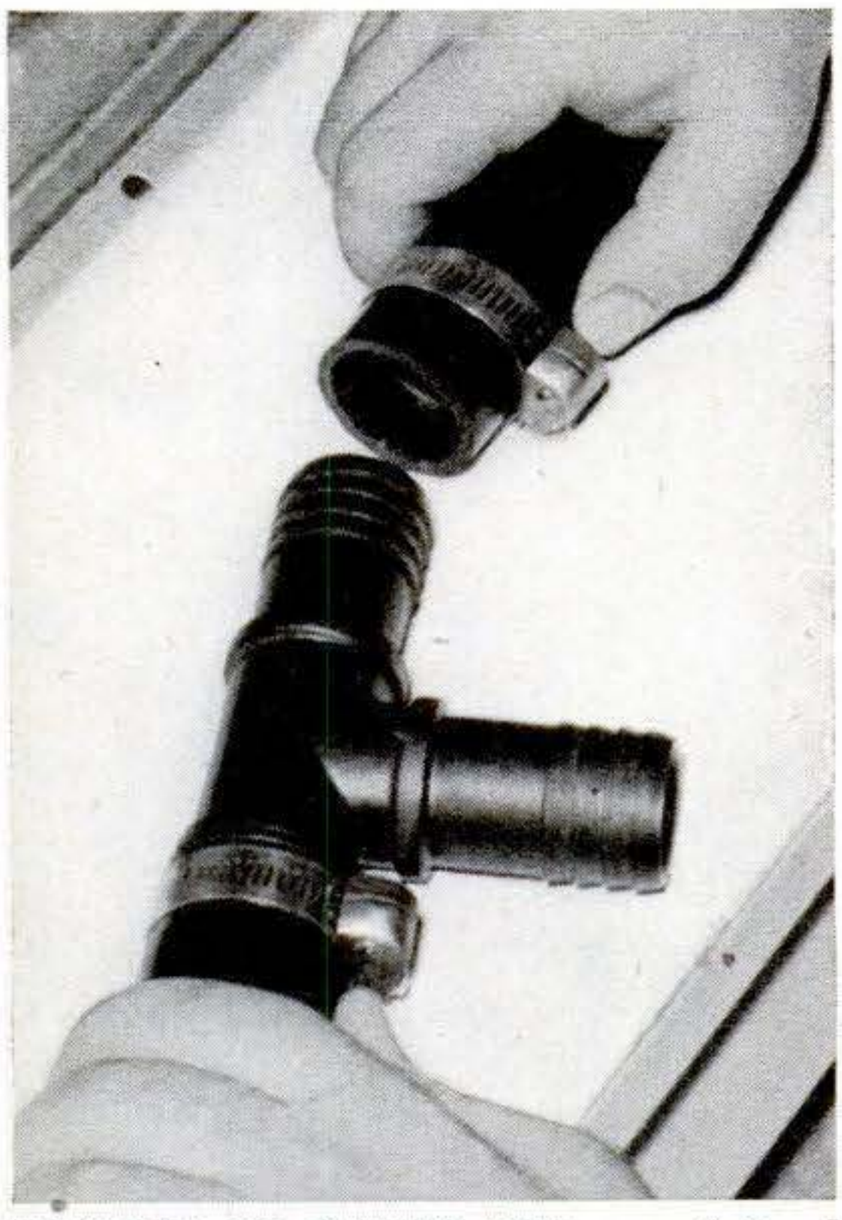
JET-WELL HOOKUP is far easier with plastic pipe. Insert adapters join the two lengths of plastic pipe to the jet. Threaded connections here are sealed with Permatex No. 2. Other standard pipe dopes are not recommended on plastic fittings. After jet is connected, the pipes slide easily down the casing. Well casing also is now being made of hard plastic.

easily formed into the necessary loops and coils. Here, as long as temperatures are kept below 160° F., all is well.

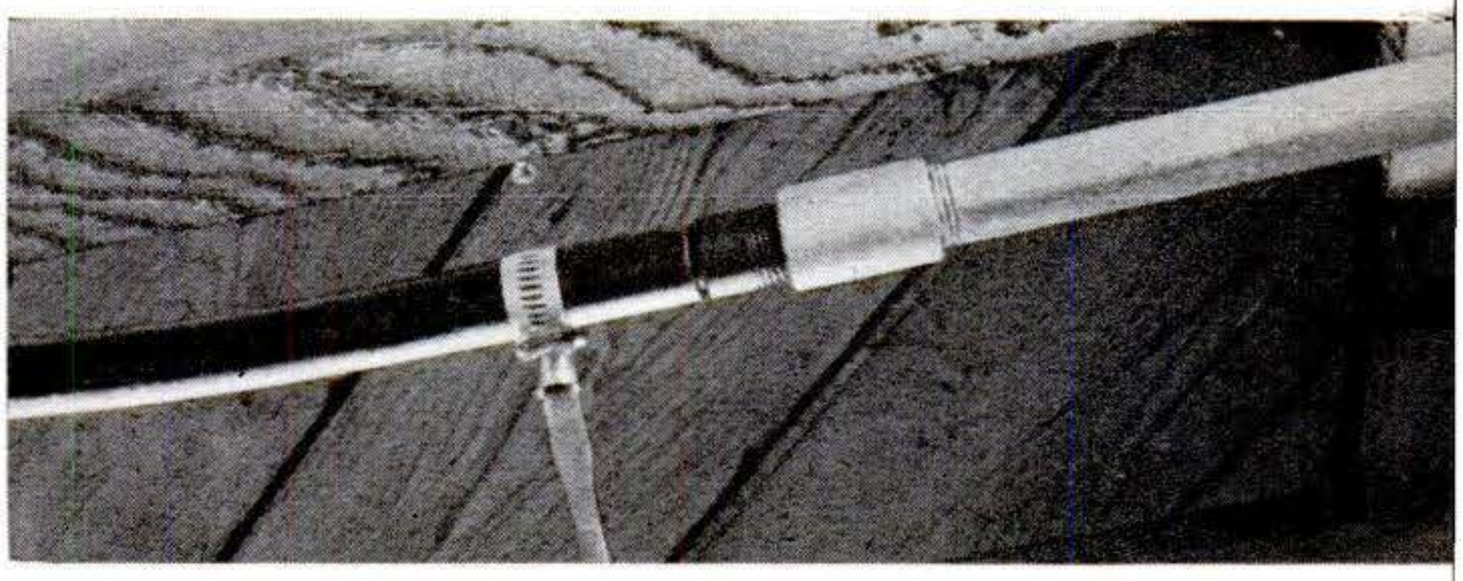
It's ideal for wells. One job where plastic pipe reigns supreme is on a jet-well installation. If you have tried to juggle a jet on the end of a double length of heavy pipe, lower it into a casing, and hold it while new pipe sections are upended and threaded into what you hope is a leakproof coupling, you know that there are easier ways to enjoy life. Pulling the pipe to make repairs is even meaner, particularly if the pipe joints are rusted solid.

All too frequently in metal pipe high friction and scale team up to throttle pump output way below capacity. Naturally, the overworked pump has a shortened life. Plastic pipe, weighing only eight lb. for every 100 lb. of metal pipe, makes the whole

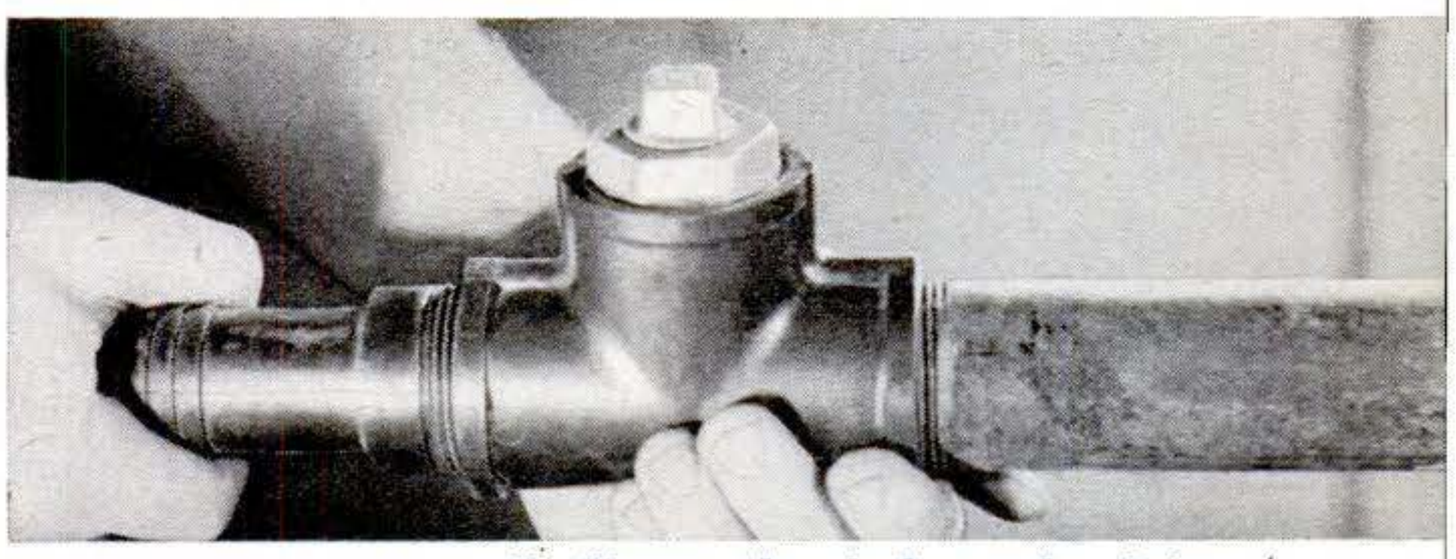
How Joints Are Made



LENGTHS OF PLASTIC PIPE are joined by clamping their ends on notched ends of an insert coupling or, as in above photo, a tee. A sealer is not needed to make joints watertight.



METAL TO PLASTIC pipe connections require no plumbing know-how. In photo above, a metal coupling receives male threads of galvanized pipe and the hard plastic insert adapter. Plastic pipe is then slipped over end of adapter and clamp tightened.



HARD PLASTIC TEES and elbows also help make joints easy. Plastic pipe plugs are available; a metal one is shown here just to prove it will work.

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job a breeze. The jet is coupled to the pipe, the whole works is poked down the casing to the desired depth without a hoist, and the upper ends are sawed off and coupled to the pump.

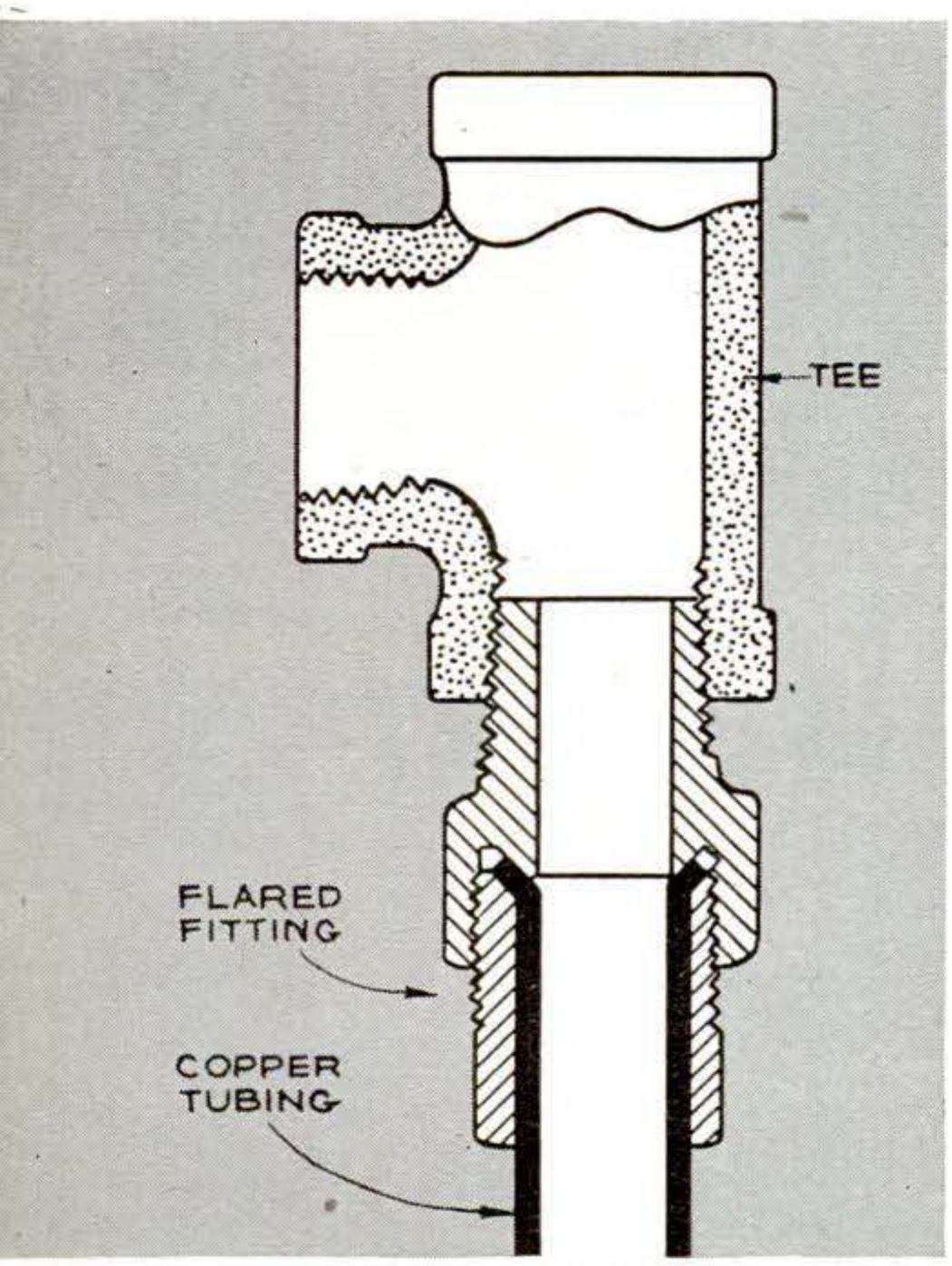
If the well gives trouble later, the plastic pipe can be pulled out intact—regardless of whether a structure has been built over the well. Jet pump installations may go as deep as 150 to 200 feet. The exact limits are established as the depth where the combined water head plus the pumping pressure does not exceed the recommended working pressure of the pipe. When you do a job like this, it is worth knowing that at least one manufacturer, the Carlon Products Corporation, of Cleveland, tests every foot of plastic pipe for eight hours at pressures well above working values.

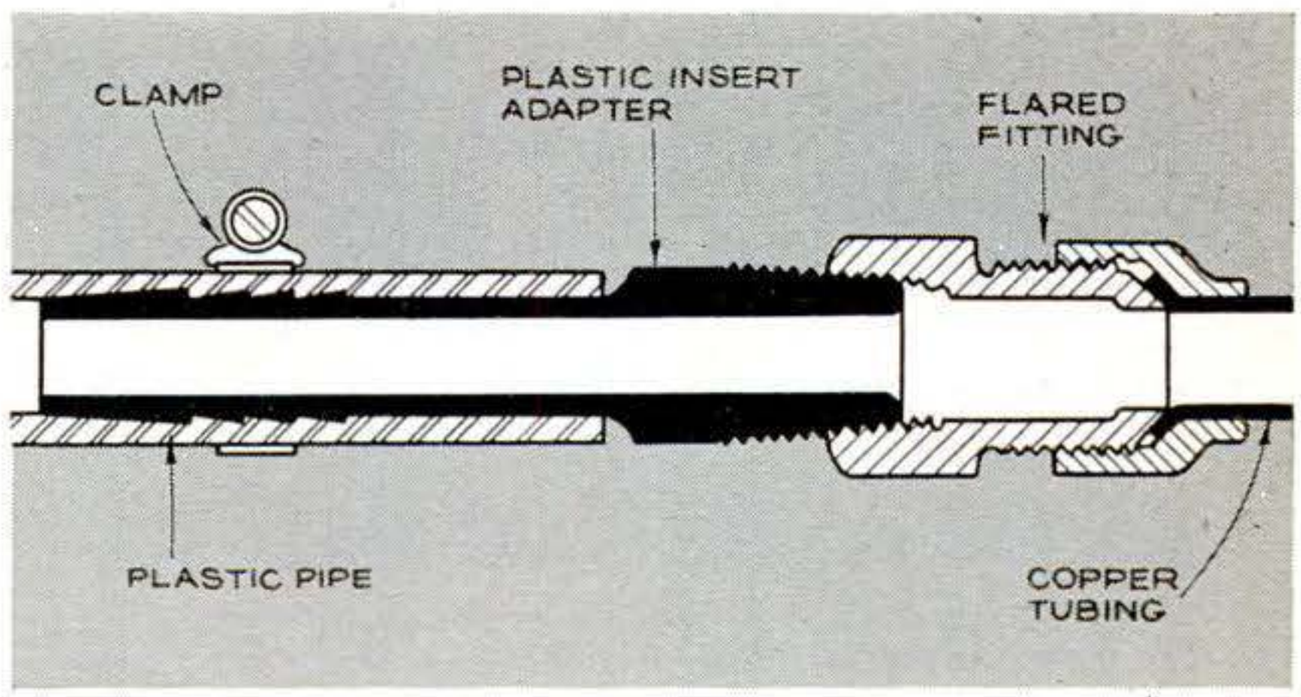
New connections are easy. Still another break to the user comes when the pipe must go into a trench. A plow furrow often suffices. Since straightness is not important, the pipe can be snaked around where it is wanted without regard for the limiting angles of conventional pipe fittings.

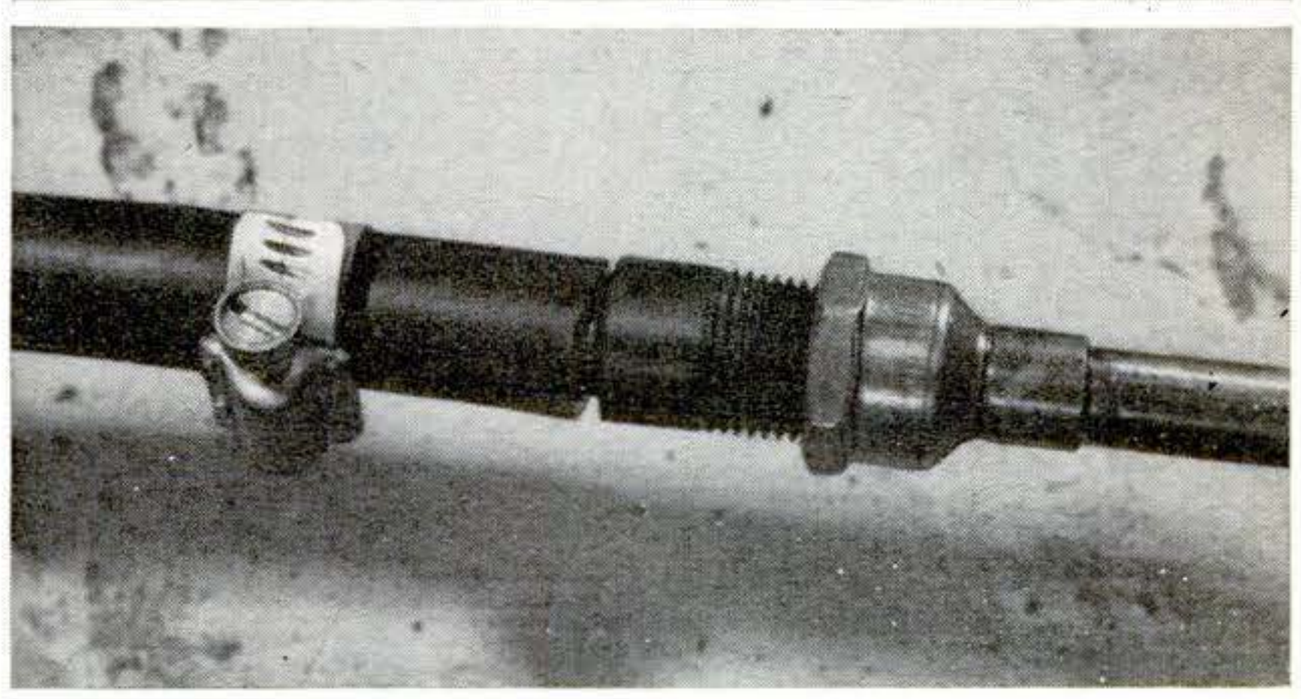
At a later time, if it is desired to intercept the original pipe with a take-off to another pipe line, no excavation of full pipe lengths for cutting and threading is required. The original pipe is sawed open, a tee clamped in, and the new lead attached without fuss or bother. This feature makes plastic pipe attractive to cities for gas and water service leads, and to the farmer with plans which will require future taps into the main line.

One inevitable problem of any new material is its acceptance in building codes. According to Walter S. Prendergast, general manager of one of the largest producers of plastic pipe, "most plumbing codes tolerate it rather than approve it." I find this understandable after listening to fiery remarks from an old-time plumbing boss who wiped the white lead and cutting oil on the seat of his overalls, shifted his chew, looked me in the eye, and delivered his opinions on homeowners who so much as *looked* for plumbing parts in a catalogue with the idea that they might do some of their own work.

From the insurance standpoint, the material is classified as "slow-burning." It is a matter of record that plastic pipe in a Texas manufacturing plant did burn through and release its water, extinguishing a fire that threatened the plant. From this, it would seem that plastic pipe carrying water through your home might also serve as a thermo-triggered sprinkler system. END







COPPER TUBING can be joined to plastic pipe with either flared or sweated fittings. The sketches show two uses of flared fittings. The photo shows how a sweated-on female connection can be used to receive the male threads of a plastic insert adapter.

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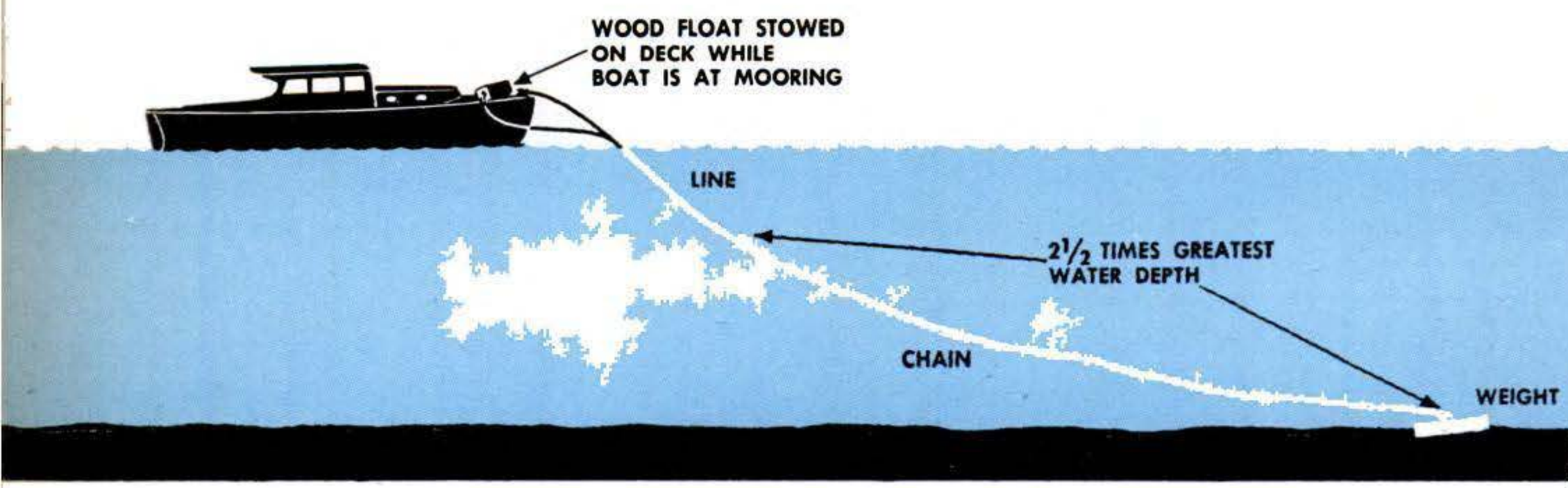
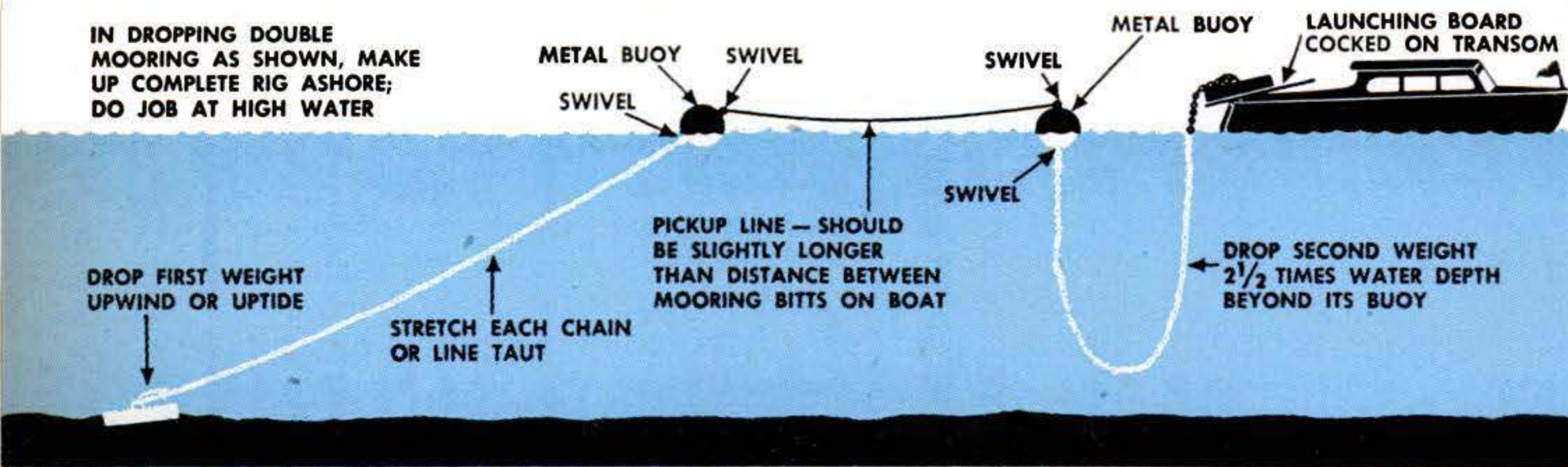
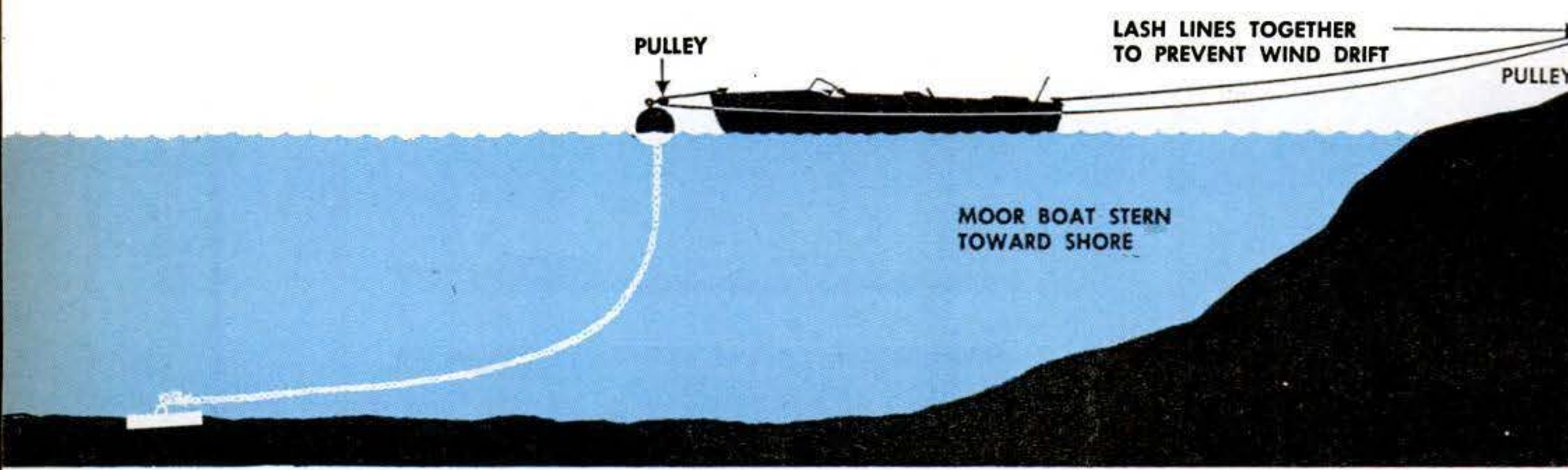


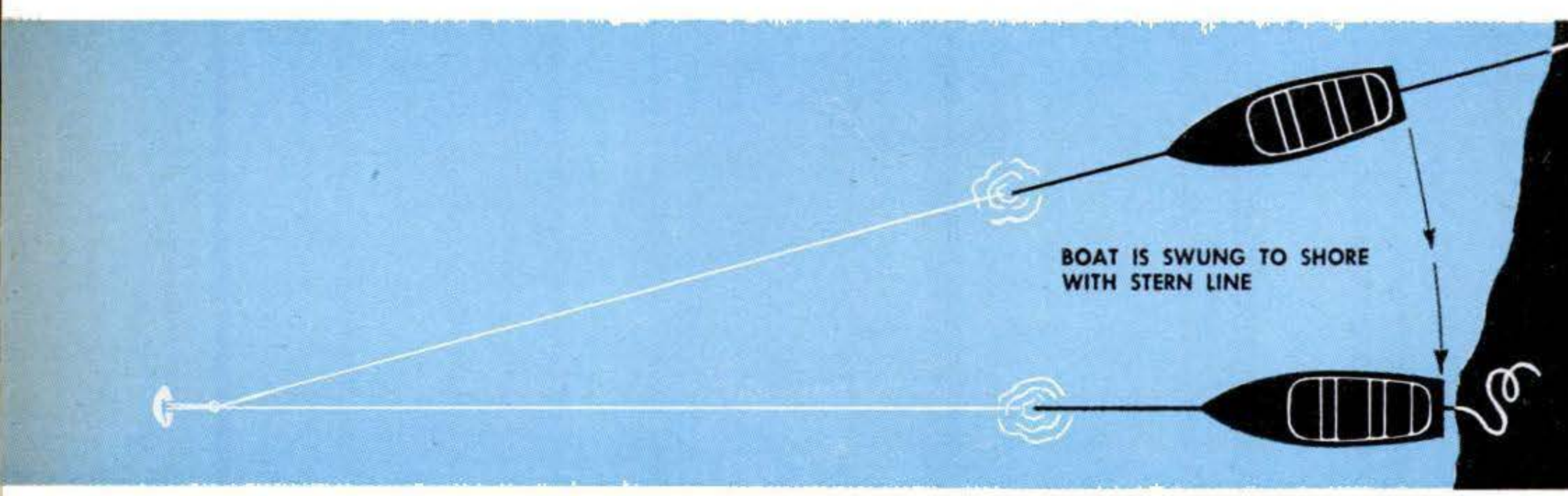
SINGLE MOORING is fine where there is plenty of room. The one shown here has line hitched to chain. To moor, you grab float, haul up line, drop an eye splice over cleat.



DOUBLE MOORING, bow and stern, is essential where space is limited. Moorings shown have chains connected directly to metal cans. Boat ties up by running a line through ring on can.



PULLEY RIG enables you to moor boat out in deep water, pull it ashore when you want it. Lines should be adjusted with care if there is much tide. Shore end can be tied to stake.



TEMPORARY ANCHOR MOORING puts you ashore without a dinghy, yet keeps your boat afloat. Stern line, fastened ashore, must be long enough to swing boat out to deep water.

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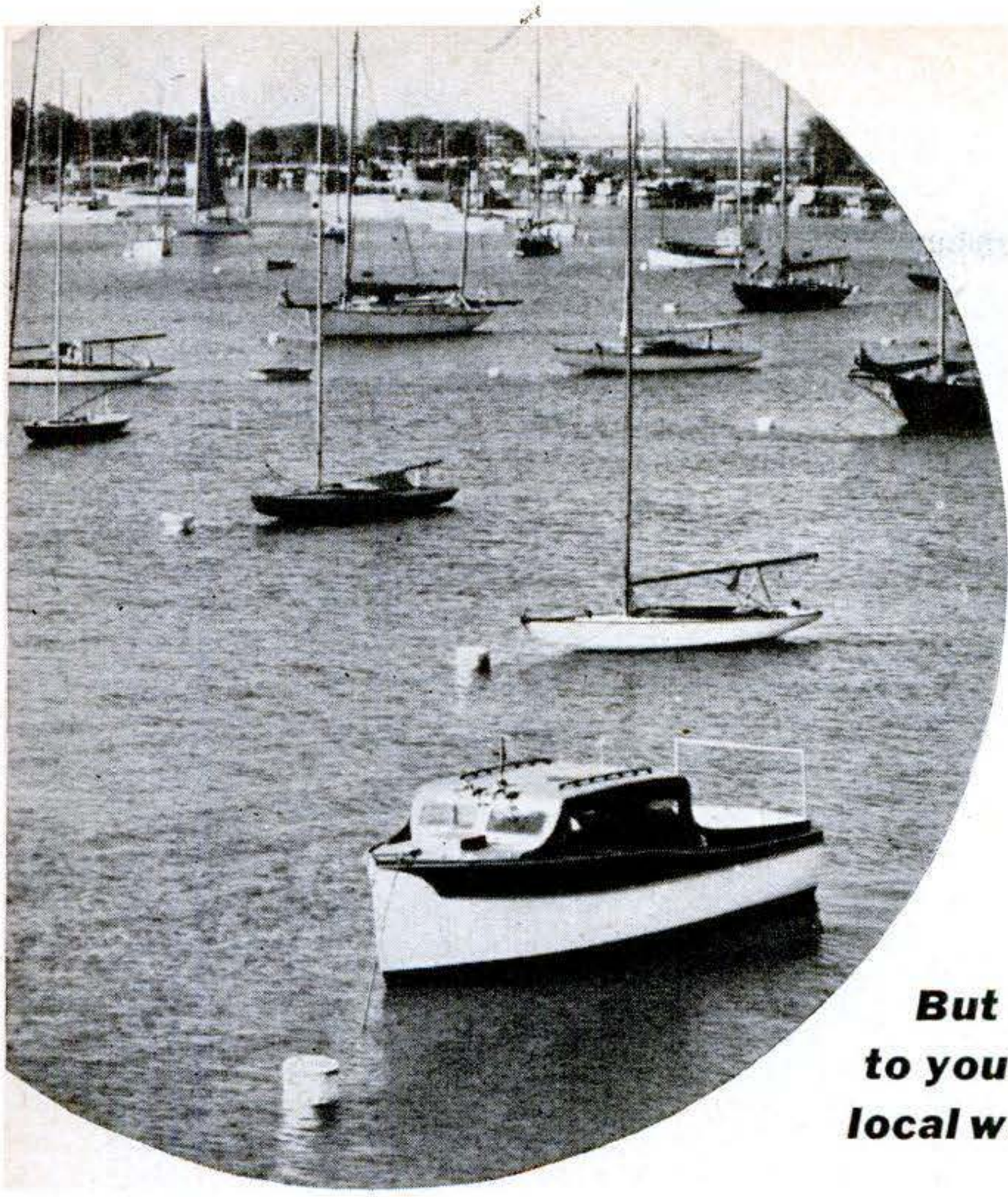

But choose the mooring best suited to your anchorage, the harbor bottom, local weather, and size and type of boat.

By Clinton R. Hull

IF YOU want to duck an aching back from loading and launching your small boat every time you use it this summer, you need either a dock or a mooring. Docks with empty berths being scarce, you'll probably have to settle for a mooring.

The idea of a mooring is simple—just a big weight dumped at the bottom of a harbor, with a line hitched to a buoy that you pick up to tie up. But to be safe your mooring must be the right weight, rig and position. Here are some suggestions.

How big? Weight, anchor chain, and rope sizes vary not only with the size of your boat but also with the location, the type of bottom, and the shelter around the anchorage. Your best bet is to ask the advice of the nearest Coast Guard station, or on small bodies of fresh water, the old-timers who know the place.

What are they made of? Iron mooring weights are best—if you can get them. In the water, all objects lose roughly 62 pounds for every cubic foot they displace. Since cast iron weighs 455 pounds a cubic foot, it loses less than a seventh of its weight submerged.

Concrete usually weighs only 144 to 150 pounds per cubic foot, so that it loses 41 to 44 percent of its weight under water. Reinforcing it with iron scrap or heavy woven wire mesh, however, can add enough weight to do the trick. Cast it in 6″ to 8″ slabs with a ring center-mounted. You may want to mold in handgrips. A favorite way of using concrete is to pile scrap metal in a big galvanized wash tub and then fill it up with mix.

Drop day. Mooring weights for most small craft are light enough so that two or three people can manhandle them into a skiff and over the side without shear legs or tackle. A heavy canvas sling with rope handles may help you grab hold. Be sure to set the weight on a launching board cocked up on the transom, so you can just lift the board and slide it over the stern. Drop at high water, and allow 2½ to three times as much chain or line as the water is deep.

How many? With the standard single mooring, a boat swings a full circle as wind and tide shift. This is fine where there's room, but for narrow quarters you'll want a double mooring—bow and stern—so you won't bump your neighbors.

What rig? You can use either a metal can fastened to a chain, or a wood float hitched to a line. With the can type, you

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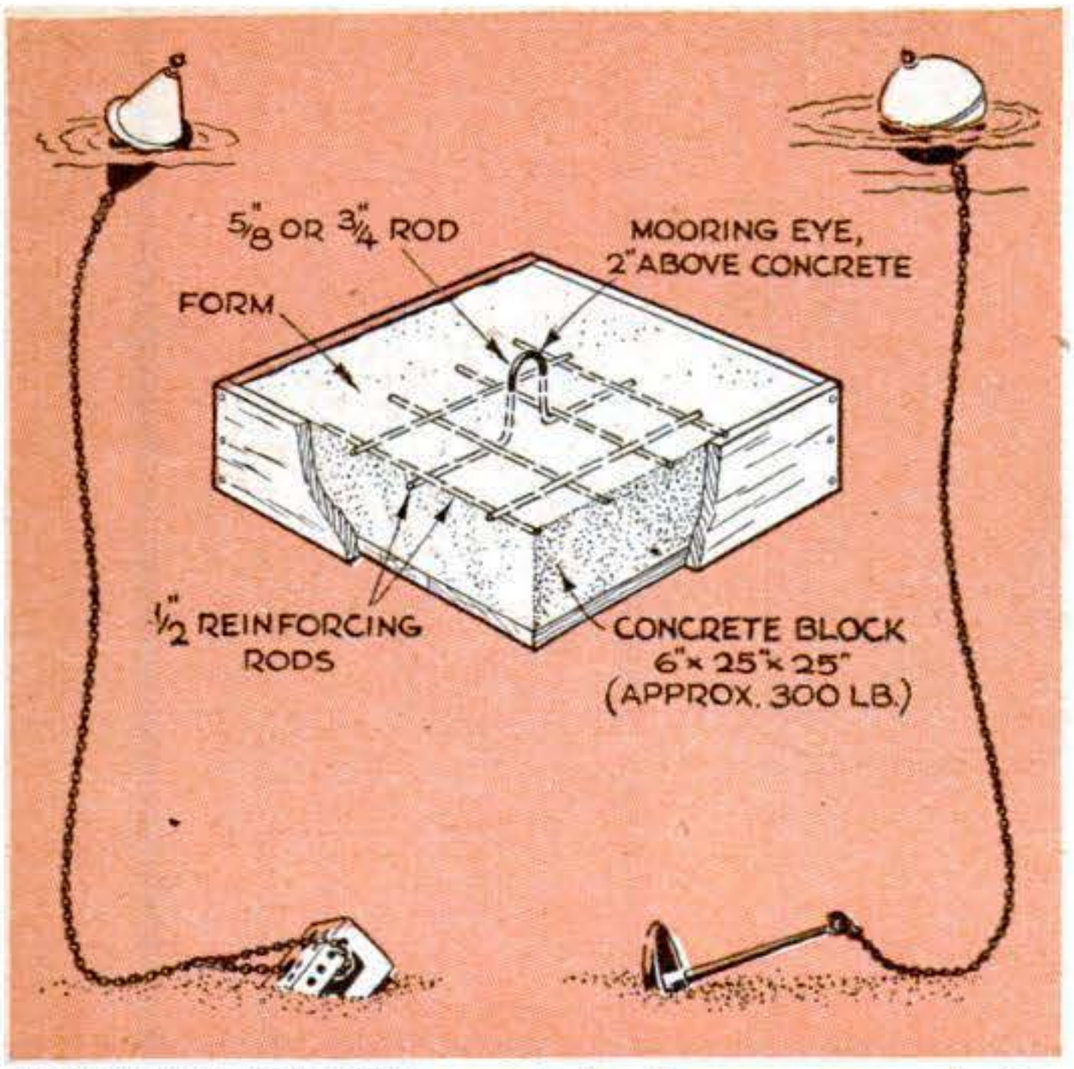


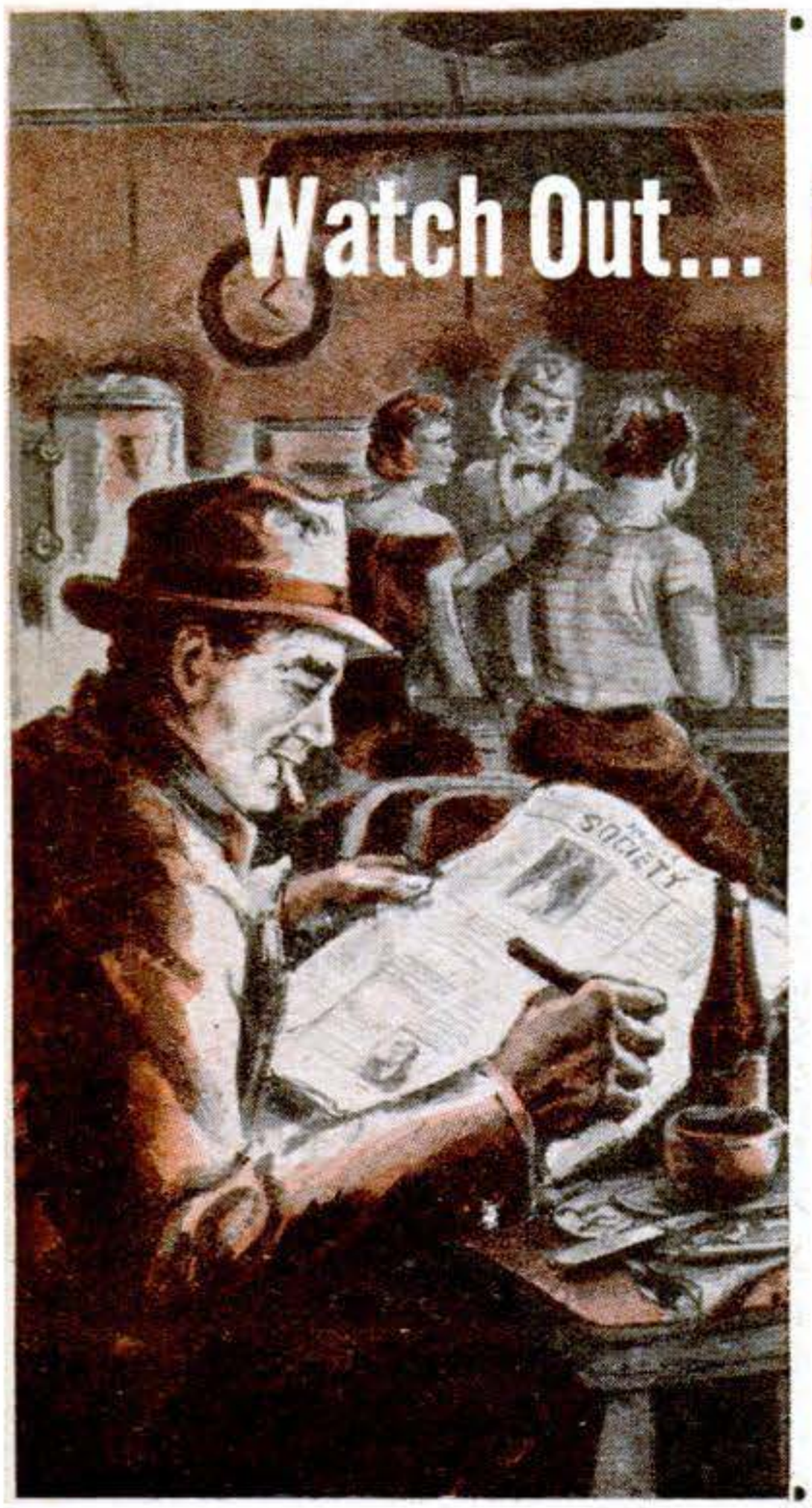
MOORING WEIGHT must be heavy enough to hold boat in high wind. Old engine block is favorite all-metal type. Heavy mushroom anchor holds where soft bottom lets it bed in.

must hook the can and tie your boat to a ring in its tip. With the float variety, you grab the float and haul up the line which is fastened to it. The line has an eye splice in the end, which is slipped over a cleat near the bow of your boat. The float is stowed on deck while you're moored.

When winter comes. If you live where winter brings ice or heavy gales, you won't want to leave your mooring out. You can take off the float and drop the chain to the bottom—and spend a week grappling for it in the spring. Or you can manhandle the weight off the bottom and drag it ashore. Better than either is to remove the float but hitch a pickup wire to the mooring chain and take it ashore. Then you just row out along the wire next spring to find the chain. But if you're moored well out in the harbor you'll need a lot of wire.

Upkeep. Chain links wear. Untreated rope becomes unsafe in 10 to 15 months in the water—and after only three to nine months in mud. You can lengthen the useful life and discourage marine growths by thorough treatment with creosote or a trade preparation like Cuprinol or Cuprolignum. Reversing bow and stern lines occasionally on double moorings increases their life.

The chain should be cleaned periodically and given a coat of asphalt-base marine paint. Paint the underwater sections of a can buoy too. Do not use copper paint on galvanized metal—and be sure that your buoy and chains are galvanized if your mooring is in salt water or water with a high mineral content. END



Watch Out... in JUNE

for burglars. FBI Chief Hoover says there are 47 burglaries every hour each day in the U.S. Thieves like to work undisturbed, as they can when you're on vacation.

THE most helpful partner the burglar has is the careless homeowner. Accumulated milk bottles, newspapers, and mail all invite thieves. Before you leave on vacation, stop all deliveries by mail or phone—not by a telltale note in milk bottle or mailbox. Lock every window and door. Put valuables in a safe-deposit box. Have the lawn mowed while you're gone. Leave shades up and tell neighbors and police you will be away; then a light in your house will alert them. **And wait until you get back to have the local society editor write up your trip. Burglars love to be notified in advance.**

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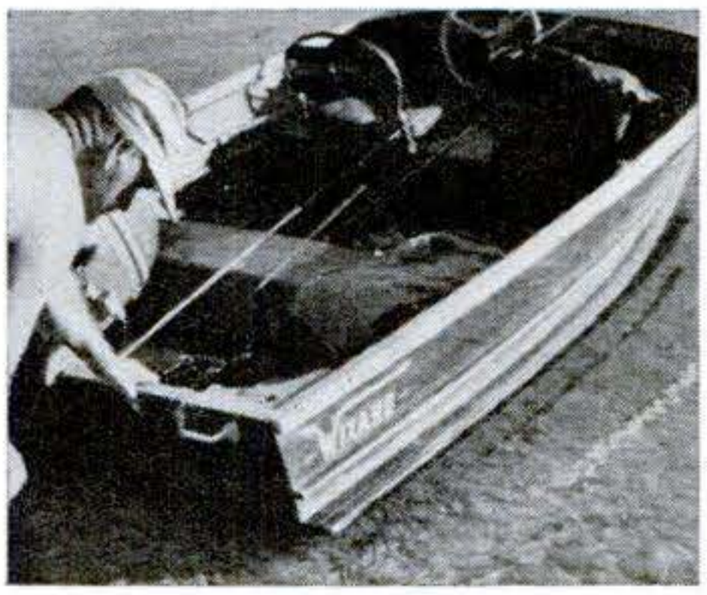
EXTRA WIDTH of rails at after end acts as planing surface to help boat ride higher, carry heavier loads faster.



AT FULL SPEED, rail-equipped outboard throws little bow spray, even with weight well forward. Rails are frequently used on large inboards as well as on small craft.

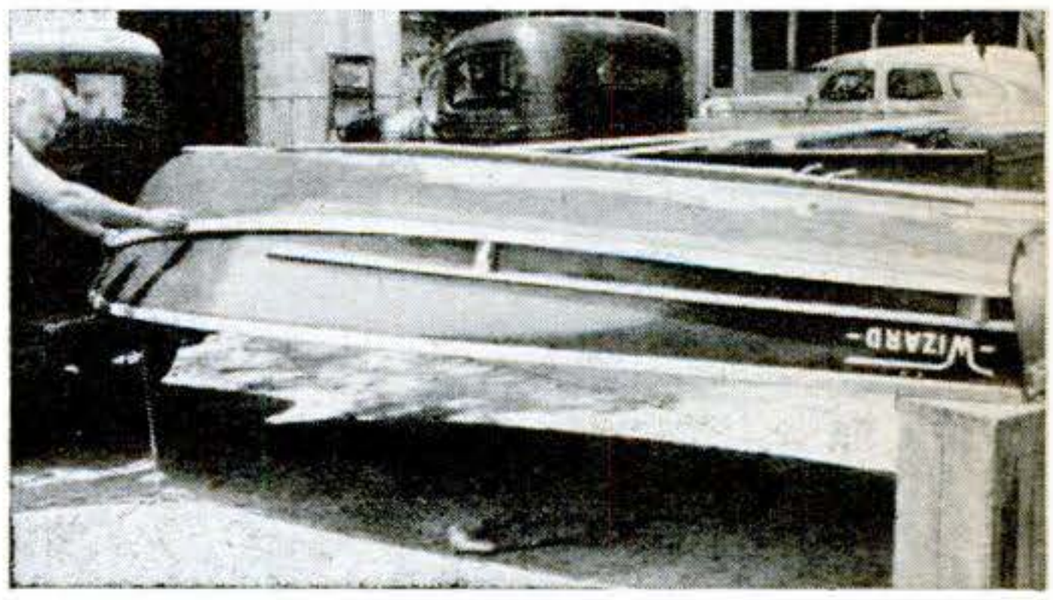
How to Add Splash Rails to an Outboard Boat

UNTIL I put on these splash rails, a full-throttle run in my boat was a dampening experience. The bow kicked up a wall of spray and the wind blew it right in my lap. On a gusty day, I really got a shower.

Now the rails keep me dry. Fastened just above the chine line where the bottom meets the sides, they catch the spray and deflect it downward. They also serve as rub rails and help the boat ride better.

The rails are 1″ by 2″, but since a piece that size would be hard to bend, I built each one up from two strips 1″ square. The first is screwed to the boat and the second is screwed on top. Having a plastic hull with no frame, I had to screw the first strip on from the inside. With frame construction, you could screw it directly in from the outside.

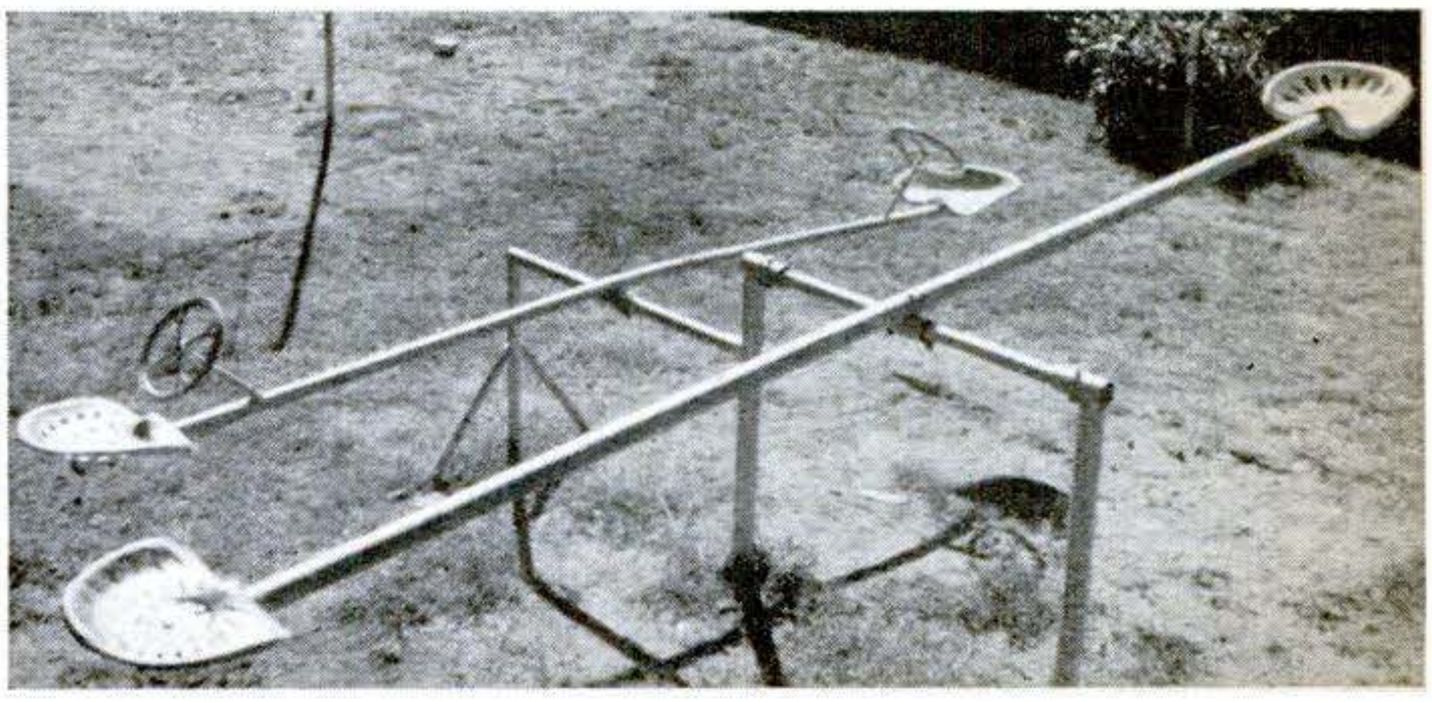
I used ash, but any tough, bendable wood will do. The rails are planed to a point at the bow and squared off at the stern.—*Clinton R. Hull, Costa Mesa, Calif.*



CURVE IN RAIL is made by fastening stern end and bending bow end down against spacer blocks bearing on original rub rail.

SECOND STRIP is screwed to first, making completed rail 2″ wide. Screws are 1¾″ No. 9 brass, spaced 8″ apart, countersunk and calked.

Seesaws Made of Scrap Pipe and Old Tractor Seats



YOUNGSTERS get a big kick out of these sturdy seesaws made of pipe. The center support is welded and bolted from old gas pipe, and the long teeter beams pivot on short lengths of pipe slipped over the support arms. Metal seats from junked farm implements are bolted to the ends of the beams, and for the tiny tots, wheels from old steam valves are welded on to make handgrips.—*George Simon, Phillipsburg, Kan.*

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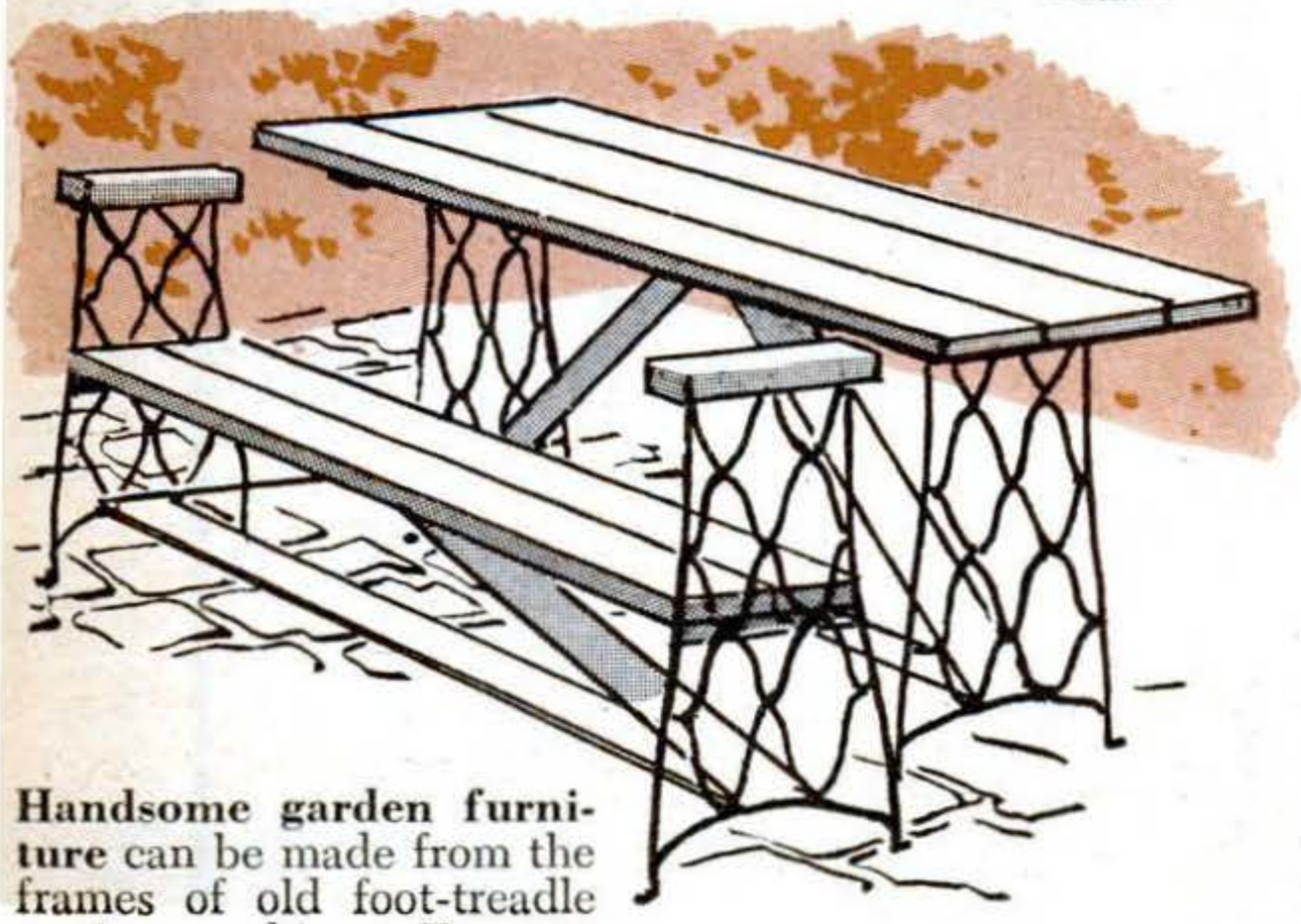
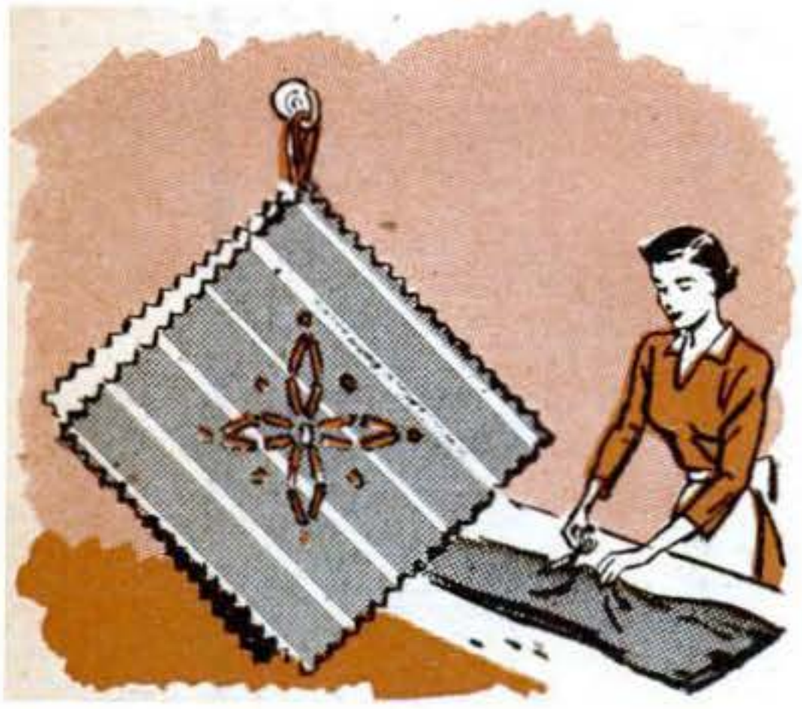
KEEPING THE Home SHIPSHAPE

Outdoor cooking leaves you with less of a clean-up chore if pots are first protected with a thin film of dried soapsuds. Then when they're removed from the fire and dunked in the dishpan, any soot will wash off with the soap.

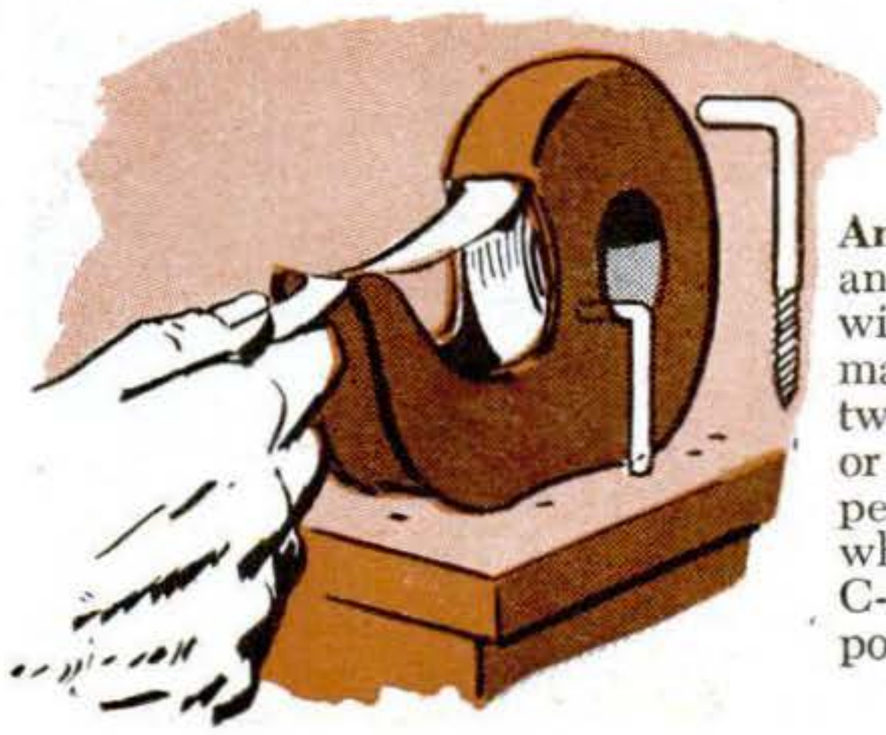


Handsome garden furniture can be made from the frames of old foot-treadle sewing machines. You can salvage the iron sidepieces from dealers who accept outmoded machines as trade-ins.

Wooden drapes dress up a window, eliminate need for curtains. The bandsawed plywood sections can be screwed to small angle brackets fixed to the top of window casings and to sides of jambs.



Fine pot holders can be made from a discarded suit, since wool is a poor conductor of heat. Cut out squares or circles with pinking shears and stitch several together with yarn at center.



Anchor the dispenser and you can tear off tape with one hand. For a permanent fix, turn down two screw hooks in table or desk until the dispenser is held firmly when slid into place. A C-clamp makes a temporary fastener.

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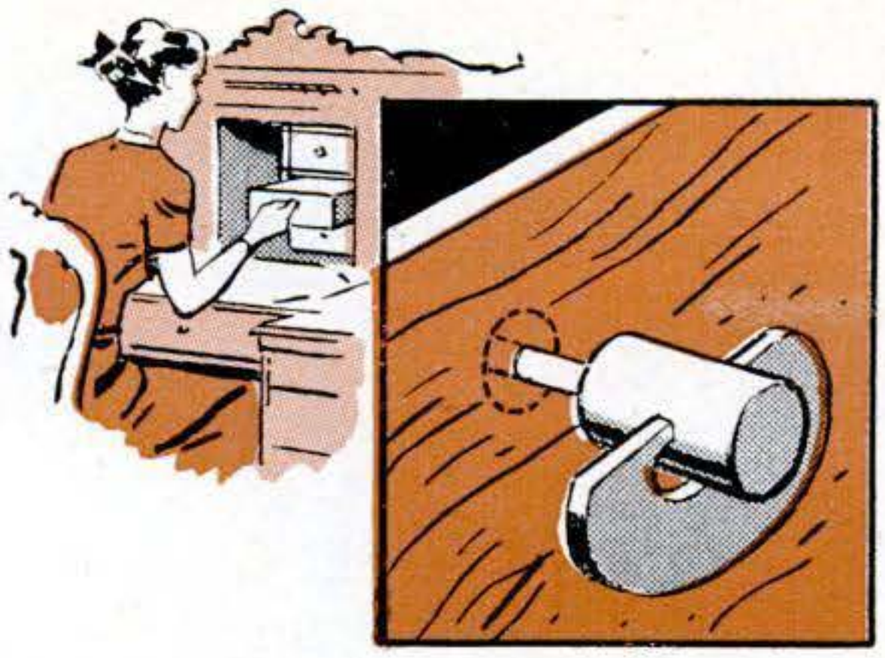
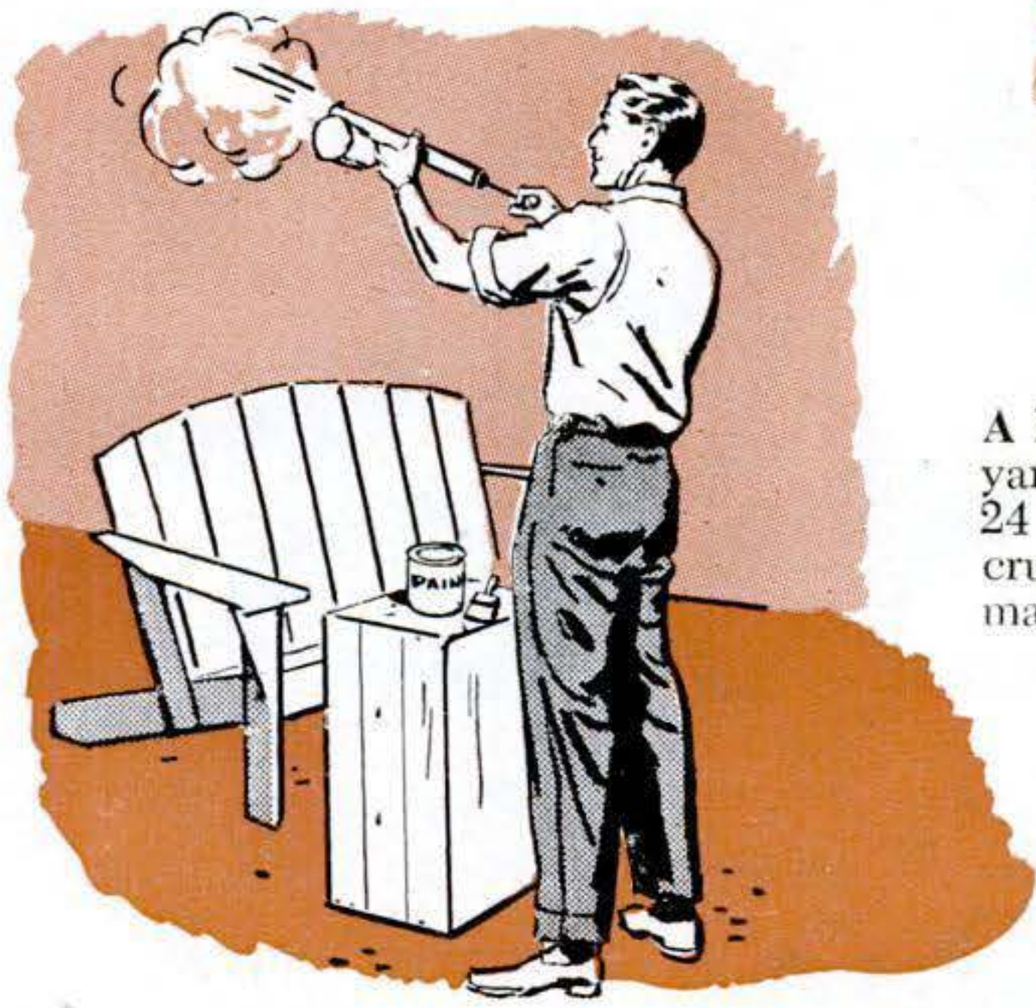
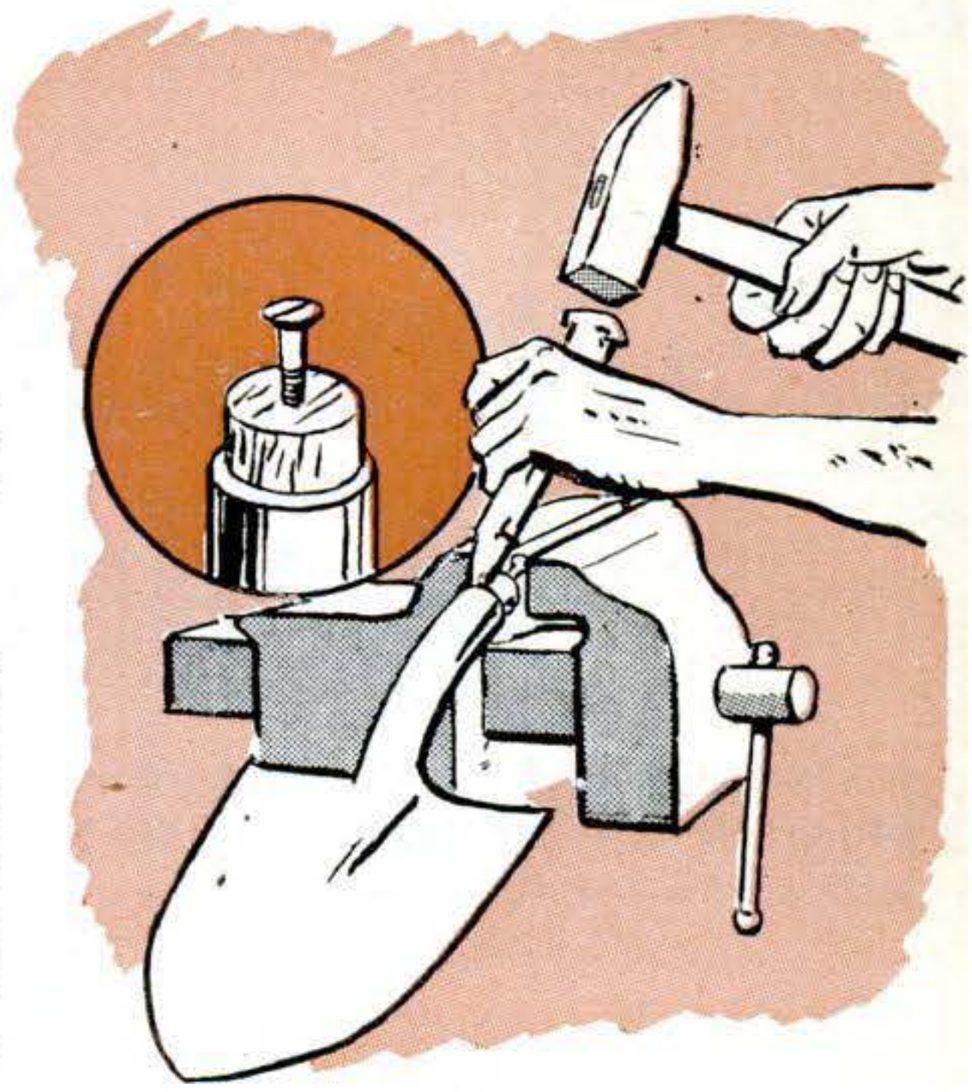


A hand pull for a small drawer is easily improvised from an alarm-clock winding key. After drilling a suitable hole, attach the key with a machine screw and a washer.

A buried ditch will sometimes drain a wet spot in the yard without ruining the look of the property. Dig it 24 inches deep and fill about a third with slag or crushed rock. Level off with dirt, then sod or plant to match the surroundings.



Settle the dust with a fine spray of water before beginning an indoor painting job. Point the spray at the floor and up in the air in a wide area around the work spot.



Wood left in the socket when a tool handle breaks can be removed like this: Saw off the wood square with the shank. Drive a heavy wood screw into the wood. Remove the retaining pin and lock the screw head in a vise. Then drive off the socket with a cold chisel.

Pull-out shelves make a linen closet easier to use. Replacing cleats and heavy shelves with sidepieces dadoed 5/16" to take ¼" plywood trays will do the job.

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Trim and colorful, this 10½′ by 15′ terrace roof cost about $50 half for the frame and half for the canvas panels. Posts can be pulled up and entire roof removed for storage in off seasons.

Canvas Sun Roof Shades Your Terrace

Water pipe and awning fittings make a sturdy frame for canvas panels that will add a lot to your summer comfort.

DON'T let that roof over your terrace, patio or porch remain a pipe dream. Build a frame of the pipe, add some canvas panels, and there's your roof—colorful, durable and inexpensive.

Ordinary water pipe does the job. If you have a good grip, you won't even need a pipe wrench; hand-tightened joints will do. No pipe dies? You can buy the pipe threaded to order. For posts up to 7′ high and rafters up to 15′ long, ¾″ pipe is heavy enough. Use 1″ pipe if frame members must be longer.

You will also need three kinds of standard awning-maker's fittings, shown at the top of the next page, plus canvas and cord.

Canvas comes in a variety of colors and weights. A grade good for four or five years runs about $1.30 a square yard. White and khaki are slightly cheaper. There are also serviceable twills and ducks at about 85 cents. The better materials are water- and mildew-proofed. Canvas will last longer if painted and stored over the winter. As such material commonly comes 30″ wide, it's economy to plan your panels in that width or some multiple of it. You'll also save trouble by ordering them with a hem at one end and grommets along the other three edges.—*Jerry Parker, Sonoma, Calif.*

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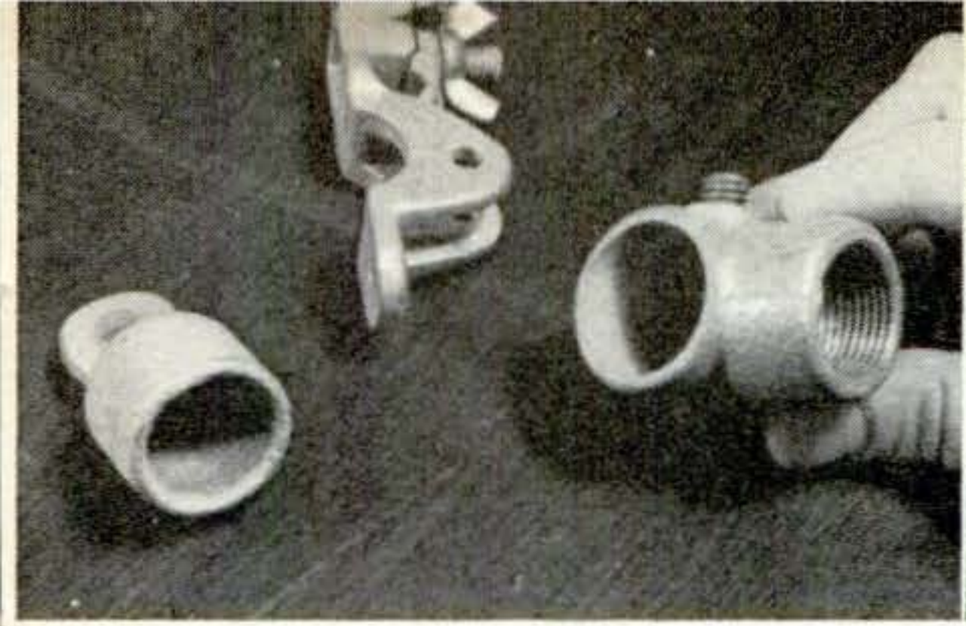
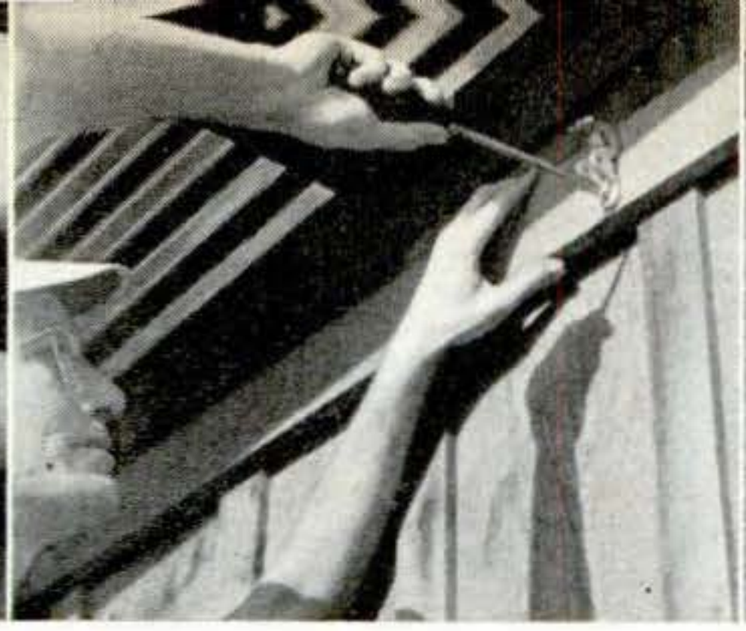
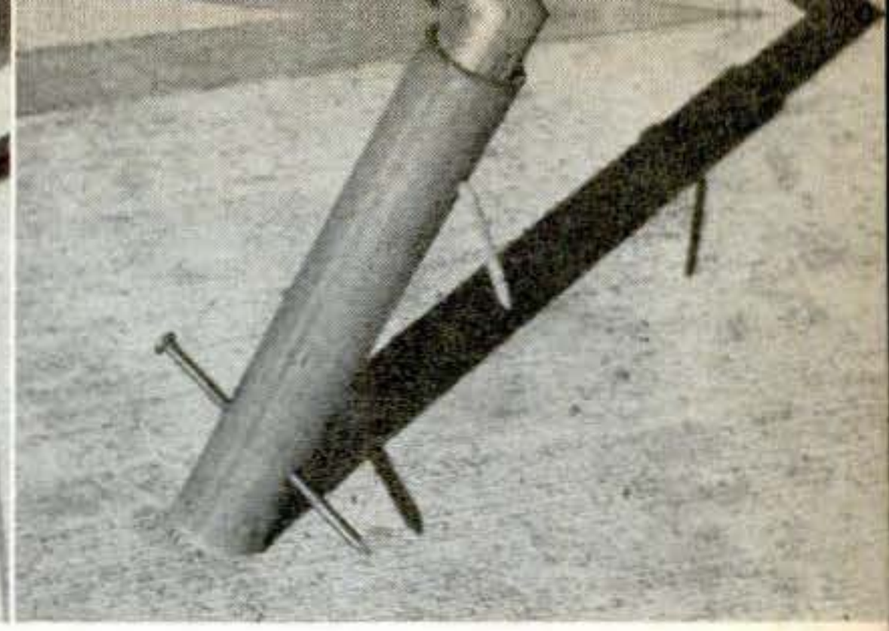


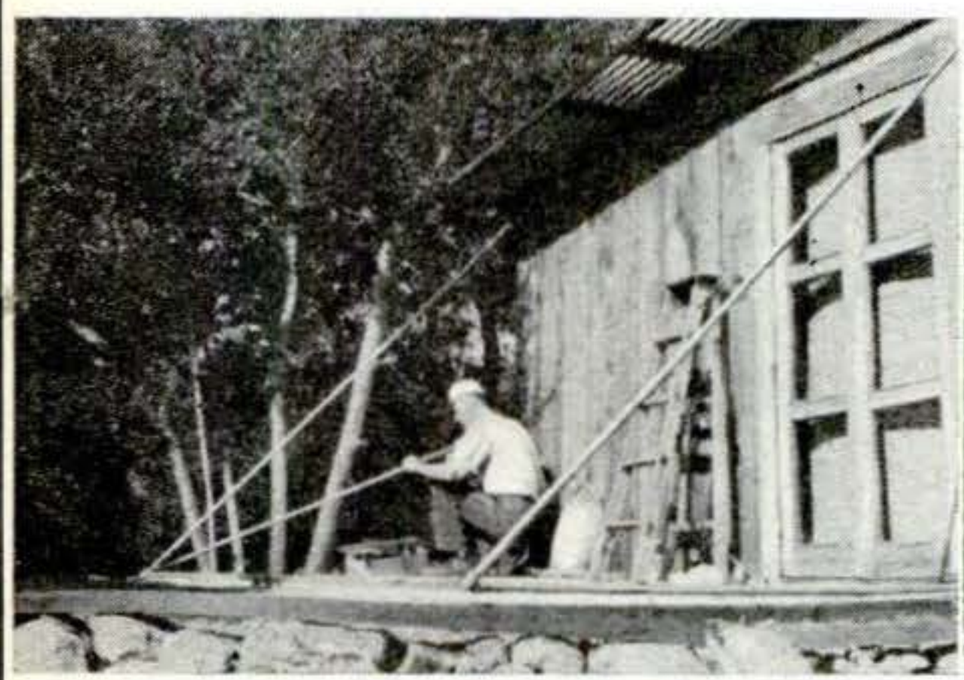
Awning-maker's fittings hold pipe together. Eye end (left above) screws on pipe, has eye to fit into rod and rafter holder (above, center). Holder also clamps a rod at 90° to rafter. Slip tee (right) has head that slides on pipe until locked by setscrew. The stem is threaded.



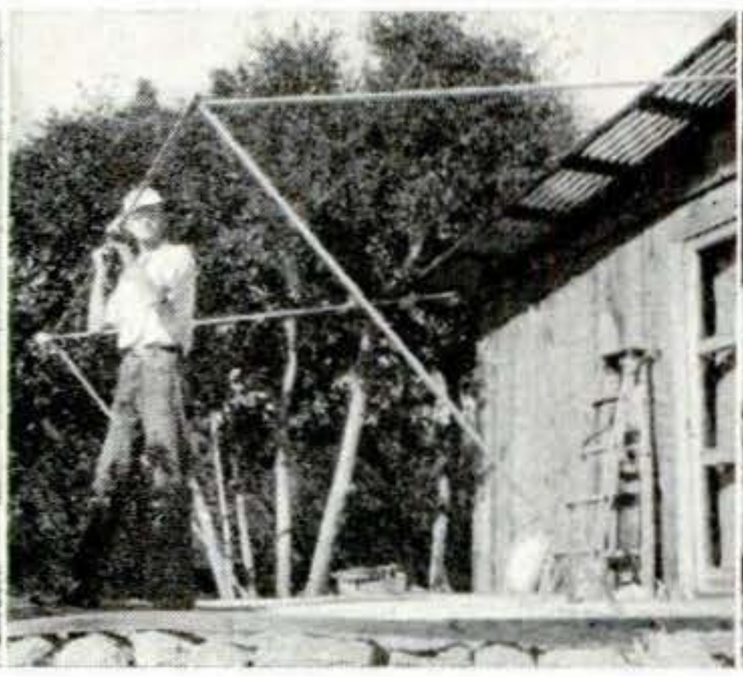
Rod and rafter holders are fastened with wood screws to one-by-four stringer on house wall. If mounted directly on wall at desired spacing, some would have been on the boards and some on battens. On smooth wall, stringer would not be needed. Four holders are 8′ above terrace floor.



Posts can be set in deck flanges bolted to a floor, or in sockets fixed in concrete. The socket above is simply a piece of larger pipe with a big nail through its lower end to anchor it in the concrete. The upper nail goes through both post and socket to lock the post in.

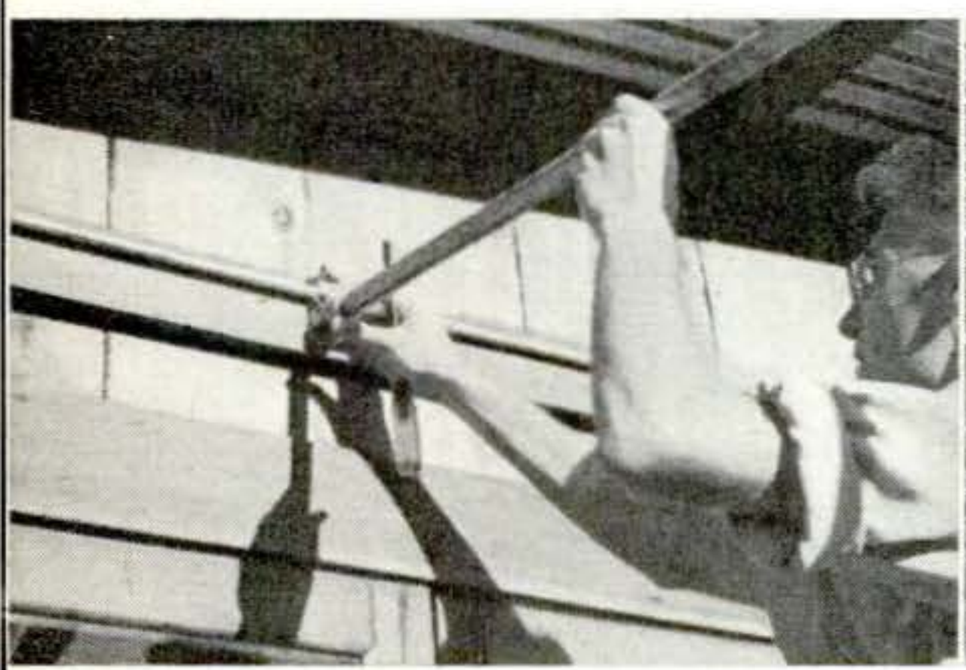


Assembly begins by screwing eye ends to the two end rafters. Three slip tees are put on the 15′ front bar. An extra tee is screwed to each outside rafter and slid on, while the eye ends are placed in the two end holders on the wall. Finally, slip tees are screwed on the end posts . . .



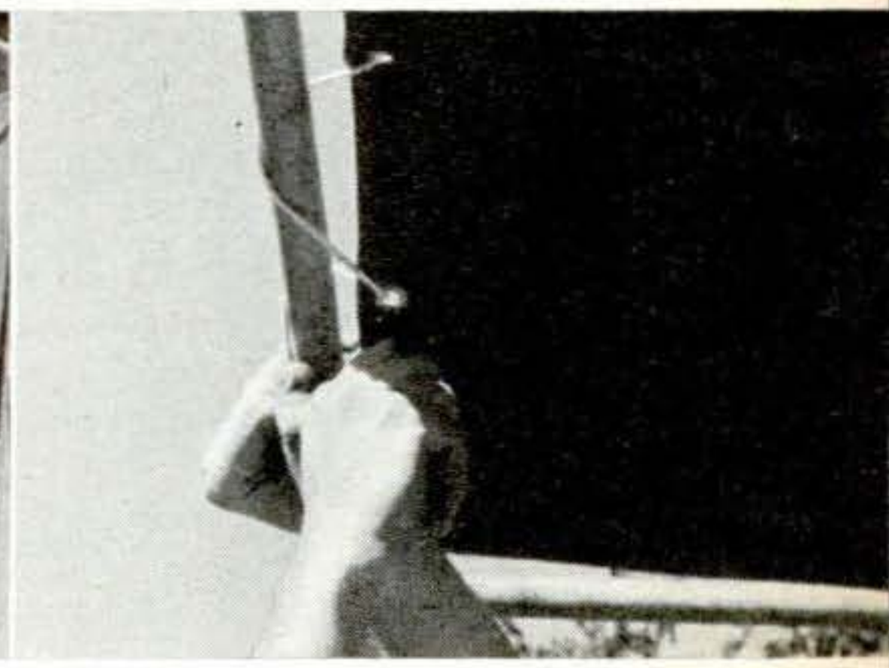
. . . **Tees are slid** onto the front bar, and the entire assembly is then raised by one man. It will stand by itself while posts are plumbed. Then, with setscrews on the tees tightened, concrete is poured around the post sockets. Recommended roof pitch is 1′ in 10.

Watch out that concrete does not bury nails that lock posts in their sockets. If it does, posts cannot be removed. To lift them out for storage, exposed nails are simply knocked out. Locking nails should not be omitted, as a high wind could then make entire roof take off.



End posts must be lifted out to screw center post into middle tee. Inside rafters are screwed into the other empty tees, eye ends put on inside rafter ends, and retained in rafter holders with bolts. Rod for canvas (parallel to wall) is also clamped in holder, as in trial assembly shown above.

Canvas panels, hemmed at one end, are slipped onto the rod, in this case a 15′ length of ¼″ pipe. This is raised above the frame so that each panel hangs in its own space. The ¼″ pipe is then clamped in rod and rafter holders with wing nuts as shown in the previous photograph.



Panels are lashed to the rafters and front bar with Venetian-blind cord through grommets set along two sides and front end about every 7″. Single cord holds two panels to each middle rafter. Lashing is made easier if the ends of the cord are first seized with heavy thread. END

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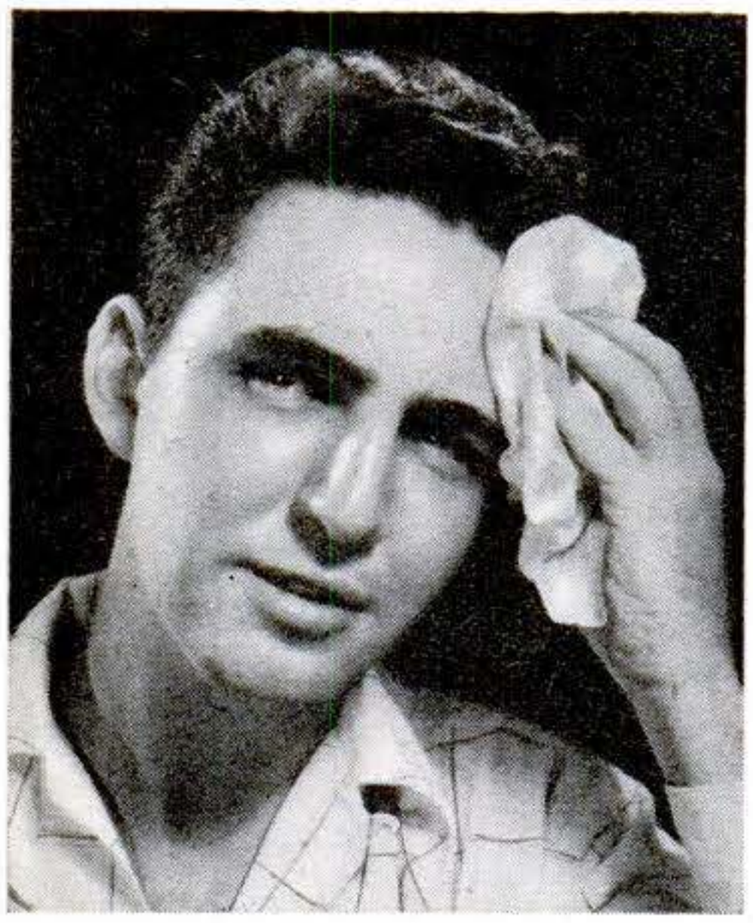


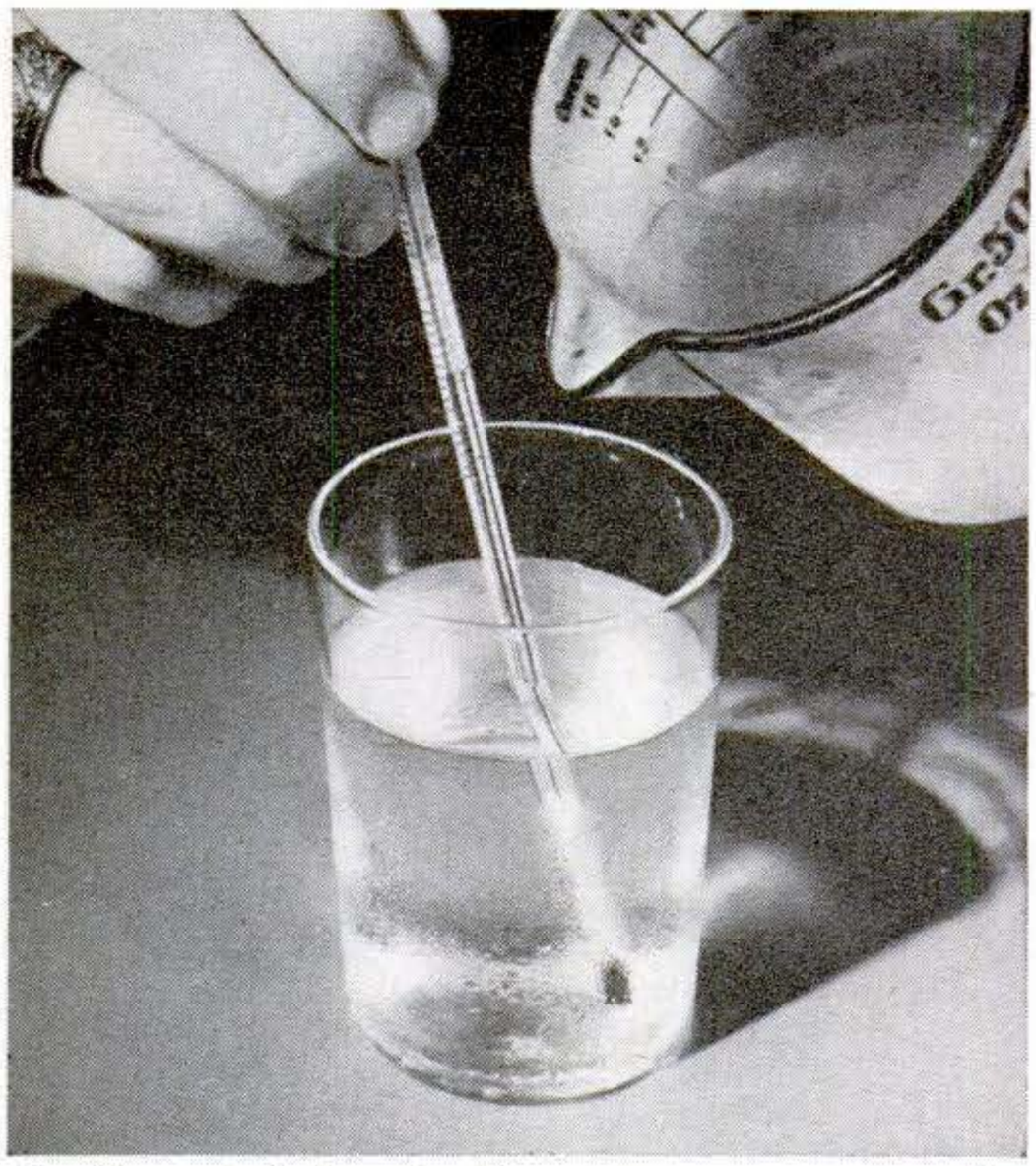
You Can Handle the Humidity

These home setups show how machines and thirsty chemicals can blot the air.

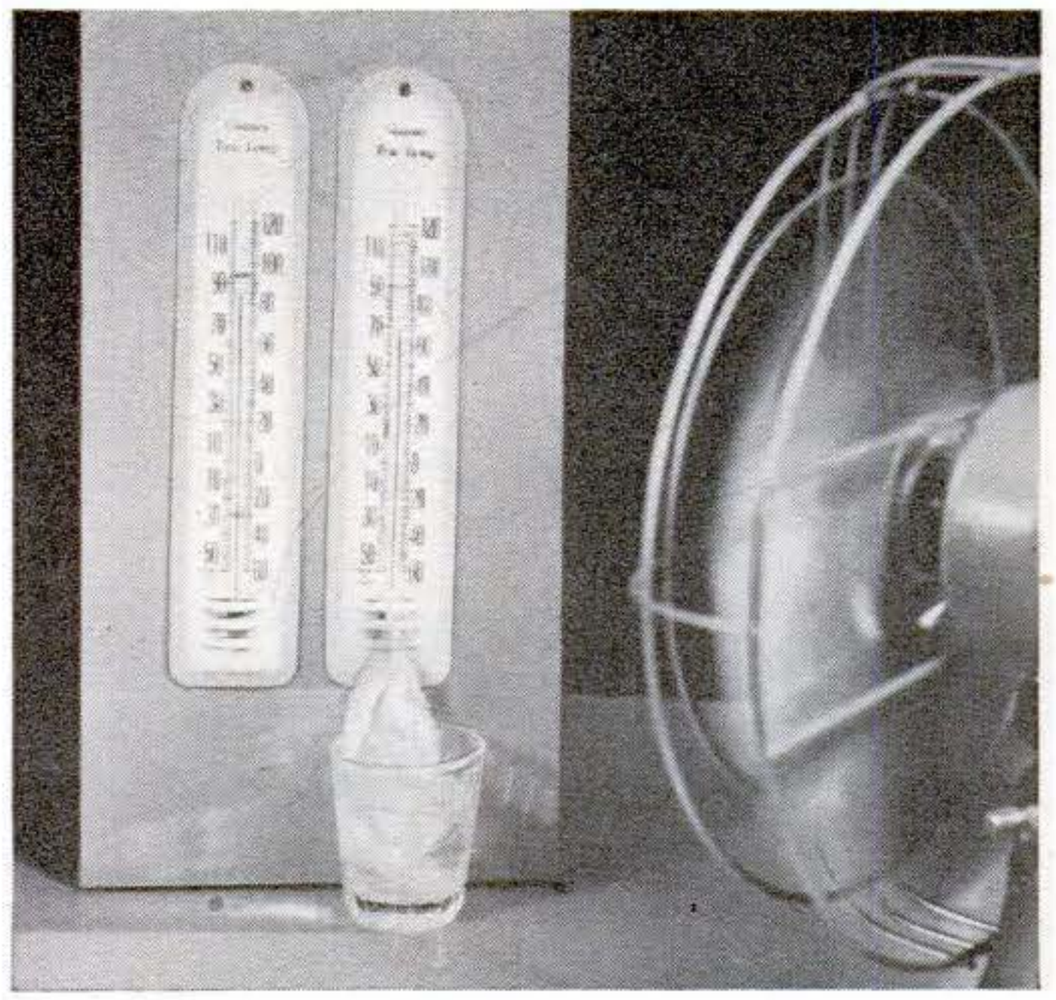
By Kenneth M. Swezey

YOU'RE right, it's the humidity. It's the humidity that leaves you gasping after a five-block walk in the sun, with your shirt stuck to your back. It's the humidity that makes your cellar shop and game room dank and unlivable. It's the humidity that rusts your tools, mildews your camera, and turns your winter shoes into fur-green slippers—moldy green, that is.

Until fairly recently, all you could do about the humidity was cuss at it. Now you can buy chemicals that drink up moisture in closets and tool chests, or a portable mechanical dehumidifier that will wring water from the air of a whole room. Here's how they work.



Cooling air below its dew point squeezes out the moisture—that's how a mechanical dehumidifier works. You can find the dew point of the air at any given time by a simple experiment. Add ice water, as shown above, to a third of a glass of water at room temperature, stirring it with a thermometer. Note carefully the temperature at which moisture first becomes visible on the glass. Stop adding water and then note the temperature at which the moisture on the glass disappears. When you average these two figures you get the dew point of the air.



A wet-and-dry-bulb hygrometer is made by hanging twin thermometers side by side. Wrap the bulb of one with a wet cloth and put the end of the cloth in a glass of water. Turn a fan on the thermometers and after a minute or two note the reading of each. The dry-bulb thermometer will give you the room temperature. The wet bulb will give a lower reading: the drier the air, the greater the difference will be between the two. The table in the next column converts this difference into relative humidity. Of course if the relative humidity is 100 percent, no water whatever will be evaporated at the wet bulb, no cooling will result, and the two temperatures will remain exactly the same. In this case you're living in a cloud.

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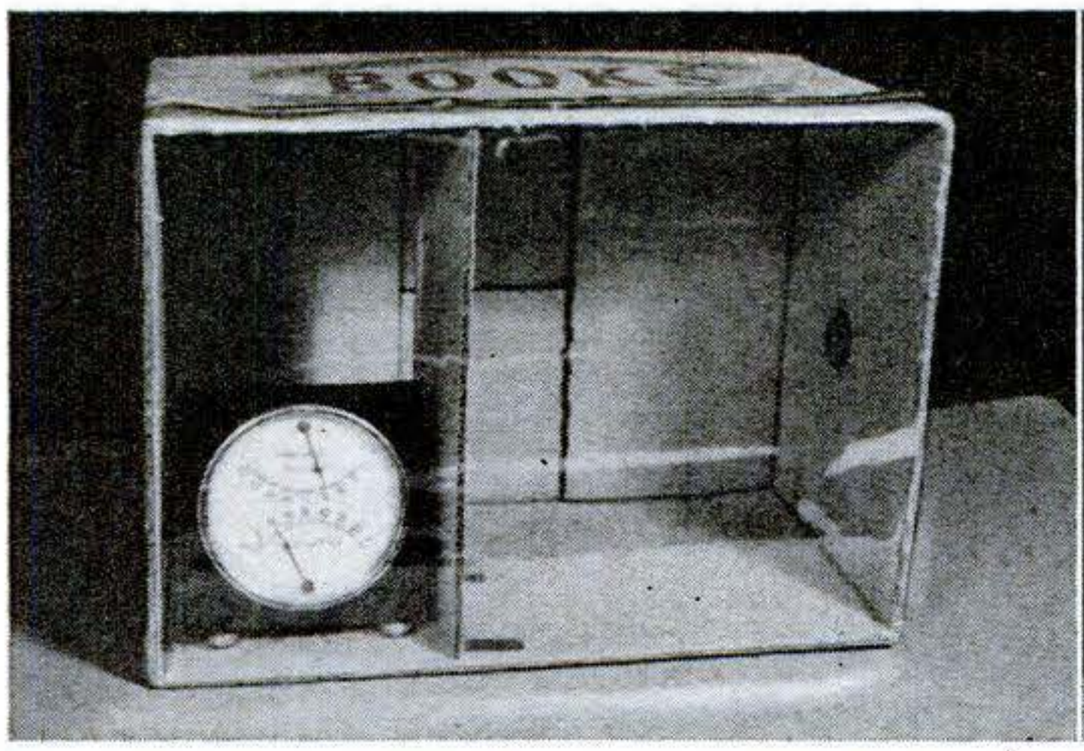
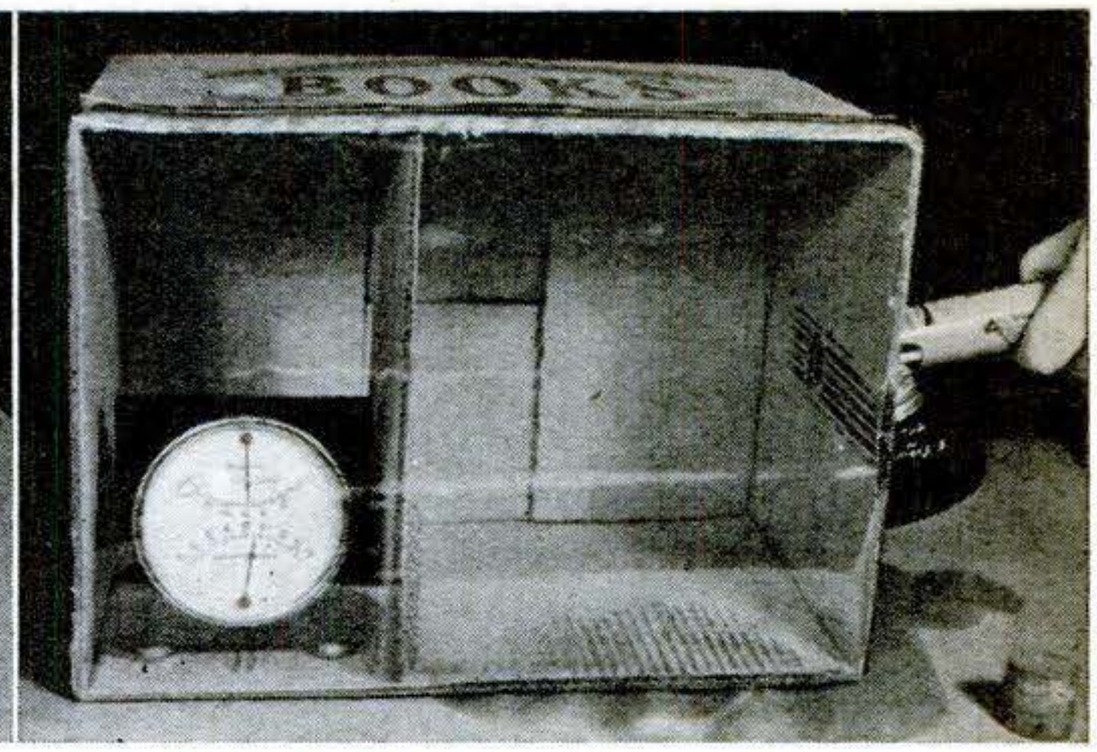




Spraying water into the air, as some home air coolers do, drops temperature but increases humidity as the homemade test chamber above shows. Make a hole in one end of the carton as shown at left, and place a temperature and humidity indicator in the other, protected from spray by a cardboard partition. Cover the open face with transparent cellulose. Start by reading temperature and humidity when carton is filled with ordinary room air. Next spray water at room temperature through hole for about half a minute, as in the right-hand picture, and plug it with a cork. After several minutes note the temperature and humidity again. You'll find the temperature has dropped but the humidity is up. The air has lost some of its heat in changing the water drops to vapor, but the moisture content of the air has increased.

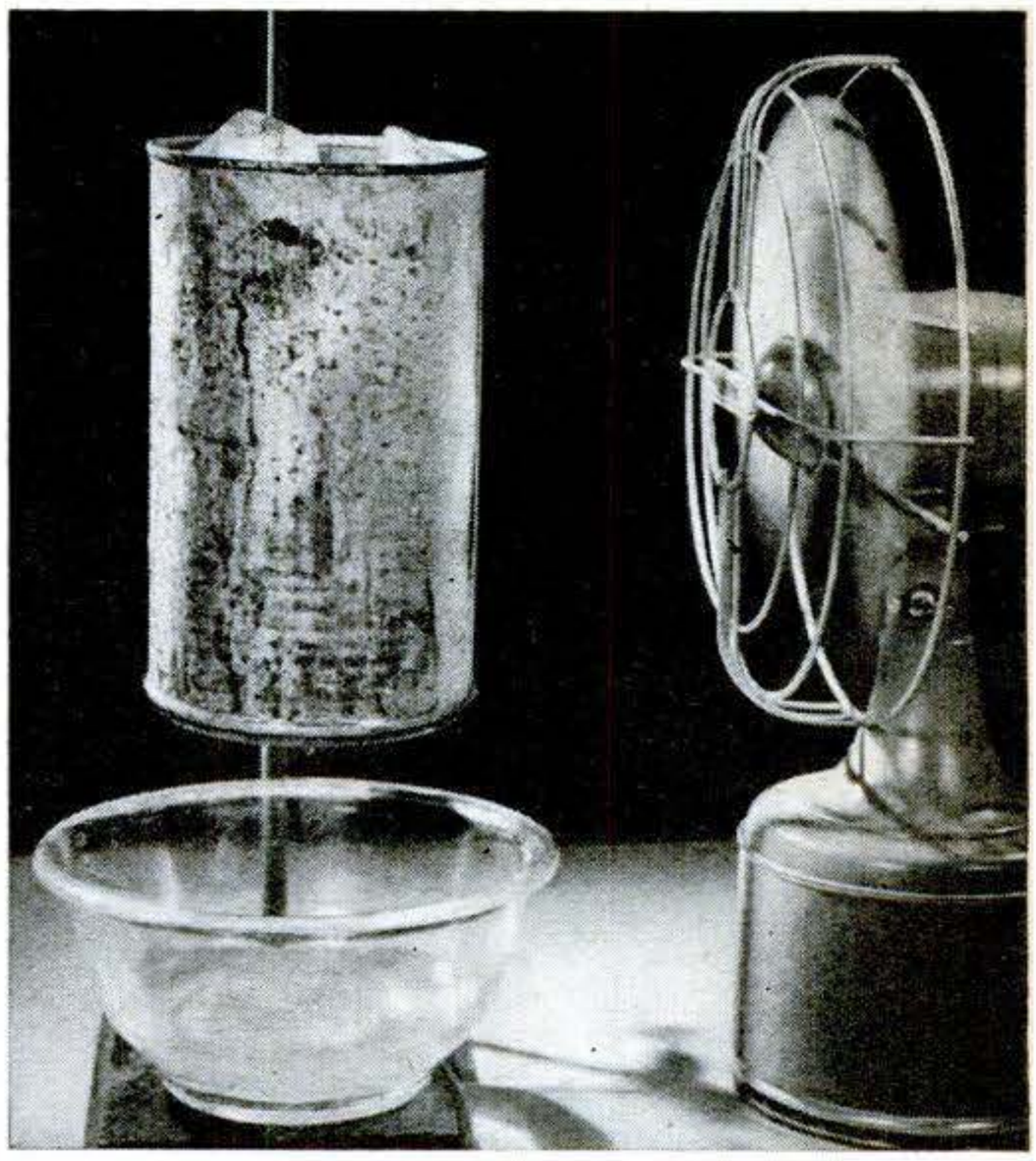
Think of the air as a sort of gaseous sponge that can hold water in the form of invisible vapor. How much water depends on the temperature: the warmer it is, the more vapor can be held. The amount of moisture actually in the air at any time is a percentage of this maximum amount, and is called the relative humidity. For example, if the temperature is 80° F., a cubic foot of air *can* hold nearly 11 grains of water vapor. If it is *actually* holding only 5½ grains, the relative humidity is 50 percent.

Suppose the temperature drops from 80° to 50°. Now the air can hold only 4 grains of water vapor per cubic foot: 1½ grains must be dumped, so that much vapor condenses into water. The temperature at which condensation starts in air of a given moisture content is called the "dew point."

Warm wet air hitting cold earth at night is chilled below its dew point and condenses water vapor on the grass. You get "dew" also in the cellar on cold-water pipes or chilly walls. A mechanical dehumidifier works the same way. Room air is chilled below its dew point by being blown across a refrigerated grid. Part of its water vapor condenses and goes down the drain; the dried air is blown back into the room.

DRY-BULB TEMP. (DEG. F.)	DIFFERENCE BETWEEN WET AND DRY BULBS				
	3°	6°	9°	12°	15°
	RELATIVE HUMIDITY (PERCENT)				
50	81	62	44	28	12
60	84	68	53	40	27
70	86	72	60	48	37
80	87	76	64	54	44
90	89	78	68	59	50

To make you comfortable, the air must be dried enough to permit your perspiration to evaporate sufficiently fast to keep your personal cooling system working. According to experts, that means a relative humidity between 30 and 70 percent. Mold, mildew and other fungi thrive best in humidities above 75 percent. Corrosion is likely to attack iron and steel if the humidity rises



How mechanical dehumidifiers work can be shown by blowing air past a can of ice cubes. As the air hits the can it is cooled past its dew point, the water vapor in it condenses and is left on the sides of the can.

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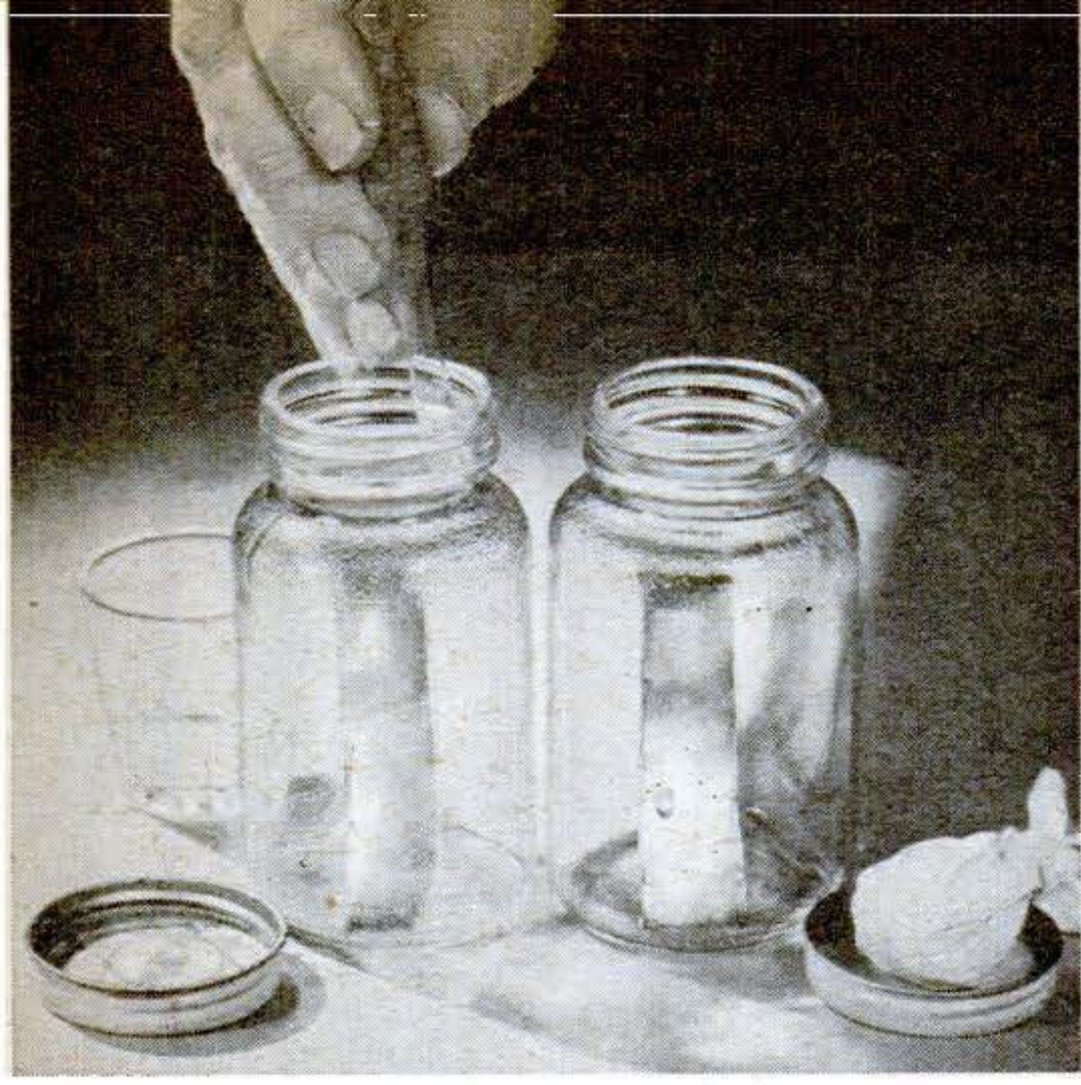

Silica gel's effectiveness in fighting rust is shown by simple test above. Hang a porous cloth bag of the chemical in a jar in which you've put a polished strip of iron and a few drops of water. For comparison, set up a similar jar without the chemical. Screw the caps of the jars on tightly and put them aside for a few days. The result is shown at the right above: the iron strip in the jar containing the silica gel is still bright; the other one is badly rusted.

much above 30 percent. For smaller rooms, closets, or drawers, chemical dehumidifiers are often used. One kind absorbs water until it dissolves. Then you throw it away. It's cheap and can be used wherever the drippings won't do any harm. A more expensive type, such as silica gel, does not dissolve but merely causes water to condense on its porous surfaces. Because there's no drip, this type is best suited for tool cabinets and other small enclosures. It can be re-used after baking in a 350° oven. If silica gel crystals are soaked in a chemical such as cobalt chloride, they will turn from blue to tattletale red when they've taken all the water they can hold and should be dried out.

Blonds preferred. One easy way to measure relative humidity is with a human hair—preferably a blond one. It expands in a humid atmosphere, contracts in a dry one, moving a pointer attached to one end. Another simple device is a wet-and-dry bulb hygrometer. It measures how quickly water evaporates, which in turn directly reflects the amount of moisture in the air—the quicker the evaporation, the drier the air. This speed is found by wetting a thermometer bulb and moving air past it. The faster the water on the bulb evaporates, the more energy in the form of heat it will take out of the air, and the lower the temperature of the wet-bulb thermometer will drop. By comparing the wet-bulb temperature with that of an ordinary thermometer nearby, the speed of evaporation—and the relative humidity—can be figured. END

Water-grabbing chemicals are used in such products as candy and tobacco to keep them from drying out. To see how a typical chemical of this sort works, stand a small open vial half-full of glycerine and another half-full of water in a large jar, which is then closed airtight. As shown in photo at right, the water level goes down from day to day, but the glycerine level rises. This is because glycerine has a lower vapor pressure than water, so it absorbs the moisture that evaporates.

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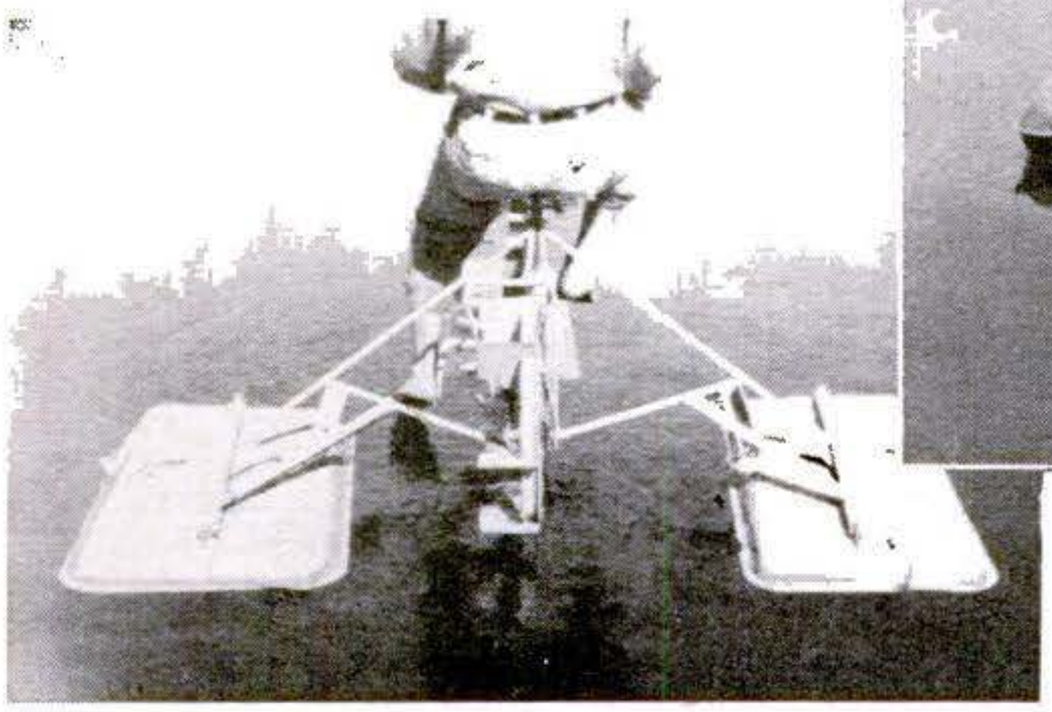
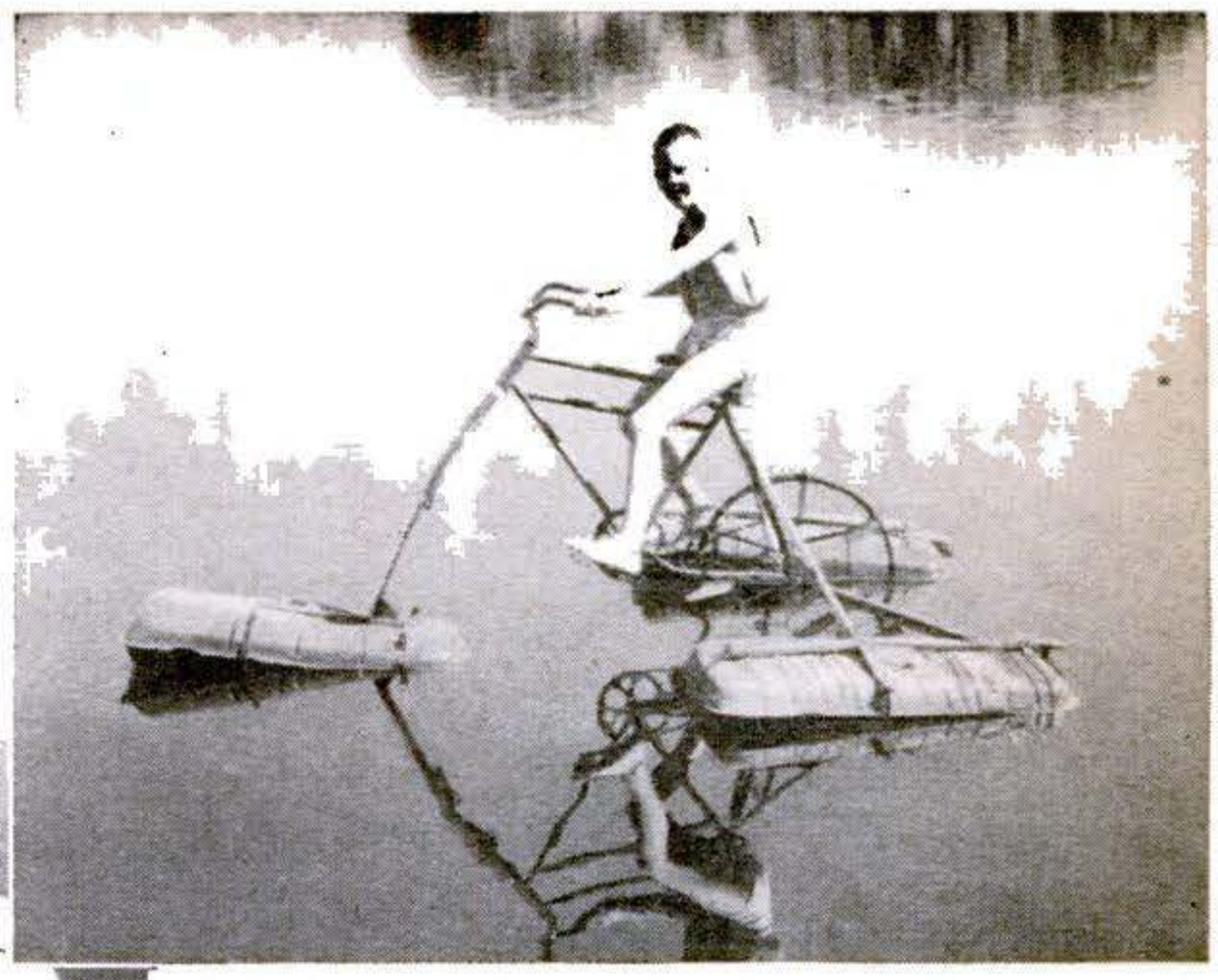
Water Trike Makes It Easy to Paddle as You Pedal





THIS old bicycle, buoyed up by three fuel tanks from an auto graveyard, lets its rider skim a lake like a giant water bug. Sheet-metal paddles welded crosswise to the wheel rim provide propulsion. A framework of ¾″ angle iron supports the bike between the floats. David Myers of Decatur, Ind., who built the water trike, welded the frame but was careful to keep the torch away from the tanks because of danger of an explosion from lingering fumes. The tanks were made airtight by soldering the seams and openings shut. The trike easily carries a 200-pound adult.

Back-Yard Grills Come from the Scrap Heap

MAJOR parts of these two back-yard barbecue grills were gleaned from junk. One is portable enough to toss in a car's luggage compartment for picnics and beach parties. The other will have to remain in the back yard, but it can be wheeled from place to place there.

The first barbecue has a bowl that comes ready-made. It is a discarded disk from a plow. To this was welded three angle-iron legs and a rim of ⅛″ steel plate. (An old-fashioned tire rim would serve as the bowl rim.) A square of welded steel mesh laid over the hole in the disk forms the grate. The grill consists of similar material.

An old iron kettle forms the firebox of the rolling barbecue. The chef can regulate his cooking by cranking a jack to vary the distance of the grill from the fire.

The kettle is bolted to a frame made of ¾″ pipe, a piece of sheet metal welded across the frame serves as a table, and a trailer wheel rolls the unit around. The grill presses snugly on a shaft welded to the end of the jackscrew, which passes up through a hole drilled in the bottom of the kettle. The fire is built on several pieces of iron rod and a disk of expanded metal lath that rest about 3″ below the top edge of the kettle.

Out of the cornfield. The bowl of this lightweight barbecue grill was once a plow disk. A steel rim was welded around the edge.

Old-time iron kettle was resurrected to serve as the fire pot for this barbecue.

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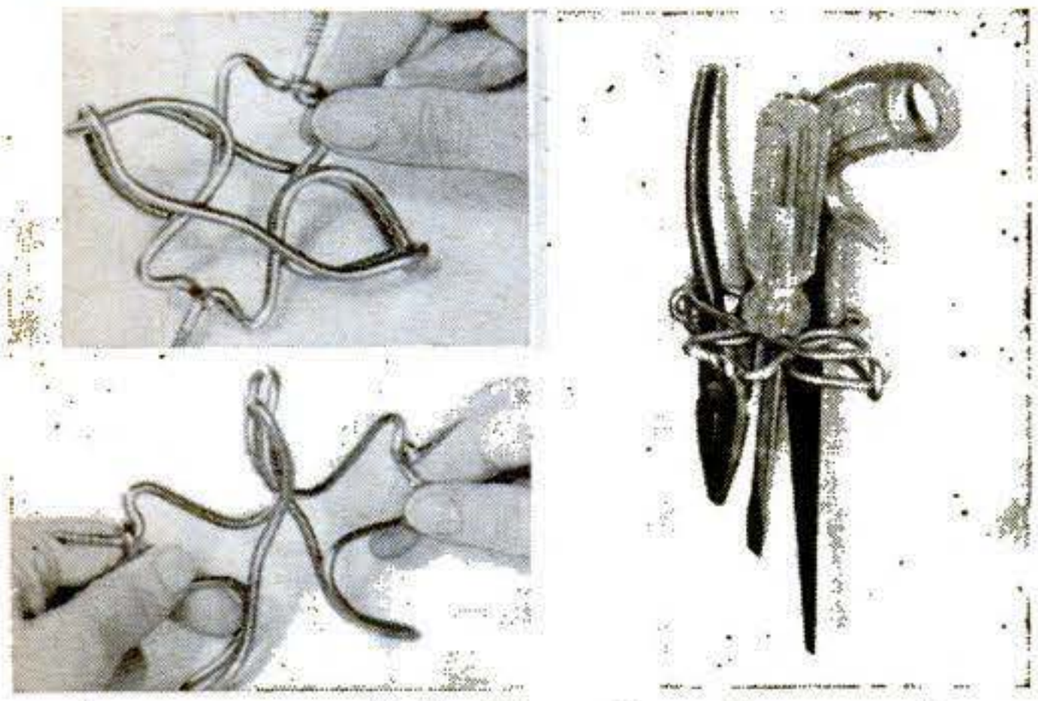
Cabinet Dries Clothes

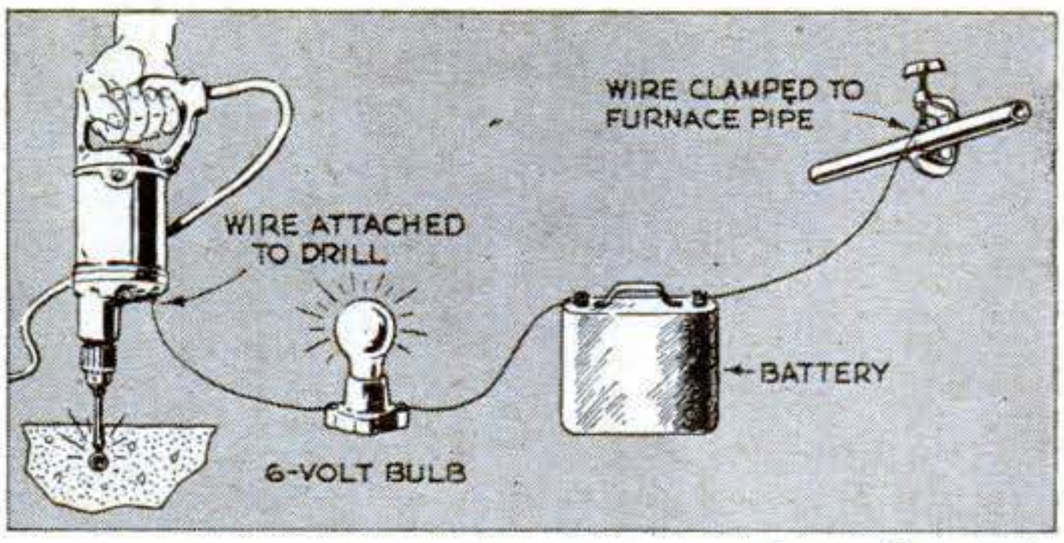
I BUILT this simple plywood cabinet so that we would have an inconspicuous drying place for nylons, woolens and other sensitive fabrics that can't be put into an automatic drier. The cabinet has a sliding rack that holds the clothes and is fitted with a counter top to match other kitchen units. I bored holes near the bottom to ventilate it and installed a fan to circulate the air.—*J. E. Brown, Pittsford, N. Y.*

Tool Holder from Coat Hooks



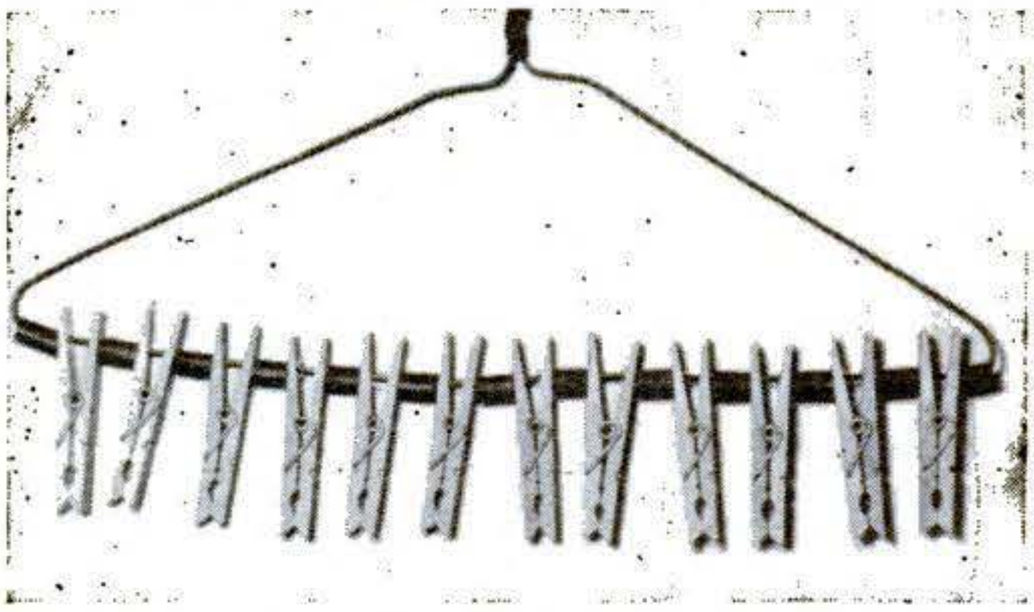
A QUICK wall holder for shop tools or kitchen utensils can be made by pressing two coat hooks together back-to-back. The spring action holds the hooks together, and they interlock to provide five openings. Screw one side into the wall and clip off the outer screw.—*J. J. Rea, Urbana, Ill.*

Light Warns of Drill Damage



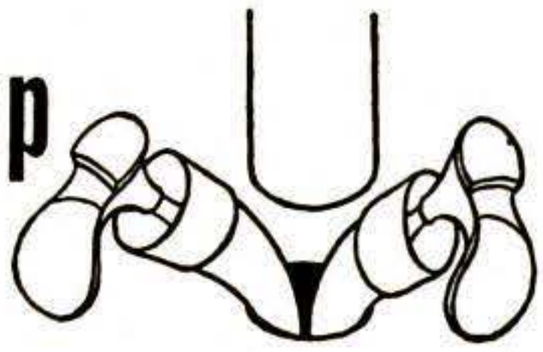
WHEN you're drilling in a radiant-heated concrete slab, this warning-light setup will let you know if you strike a pipe in time to avoid damaging it. Connect a six-volt battery and bulb in series with a furnace pipe and your drill, as shown above. Then if the drill point strikes metal, the circuit will be completed through the house plumbing and the bulb will light.—*O. L. Long, Manhattan Beach, Calif.*

Film Drier Takes Small Space



DRYING cut films on spring clips takes too much space because they hang side by side. By boring holes in ordinary clothespins and stringing them on a coat hanger, a dozen films can be hung in a small space. Unwind the hanger, slip them on with tubing for spacers, and refasten the hanger with tape.—*A. L. Schoeni, Falls Church, Va.*

Workshop Wisdom



Now shed a brief tear for Joe Gunch,
Who worked on a big power punch.
By nature too hasty,
He bypassed the safety.
The last heard of Joe was a crunch.

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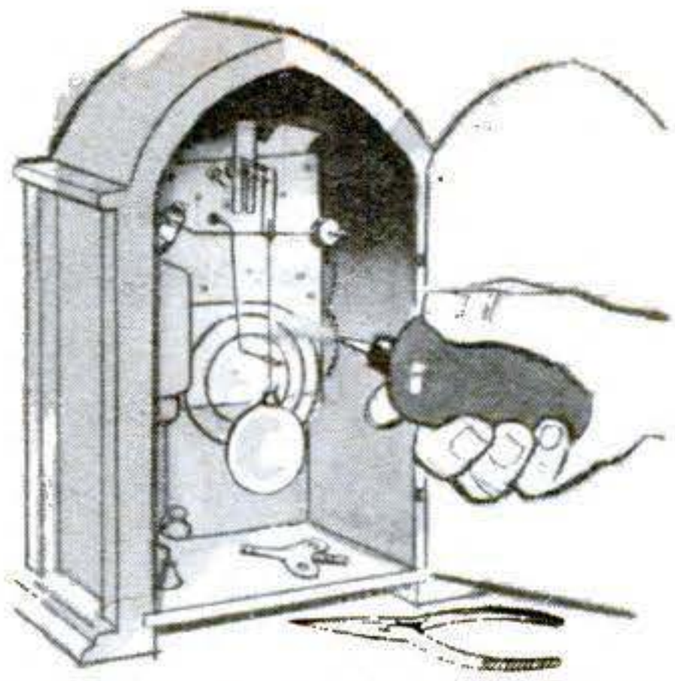
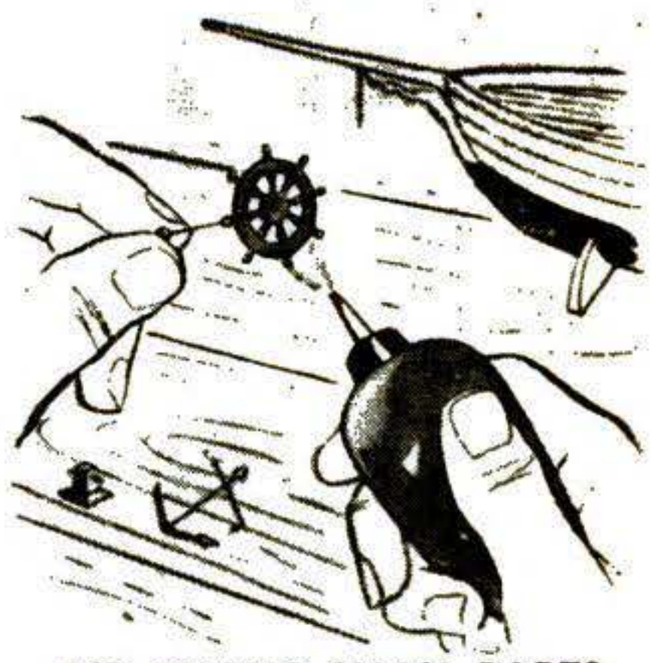
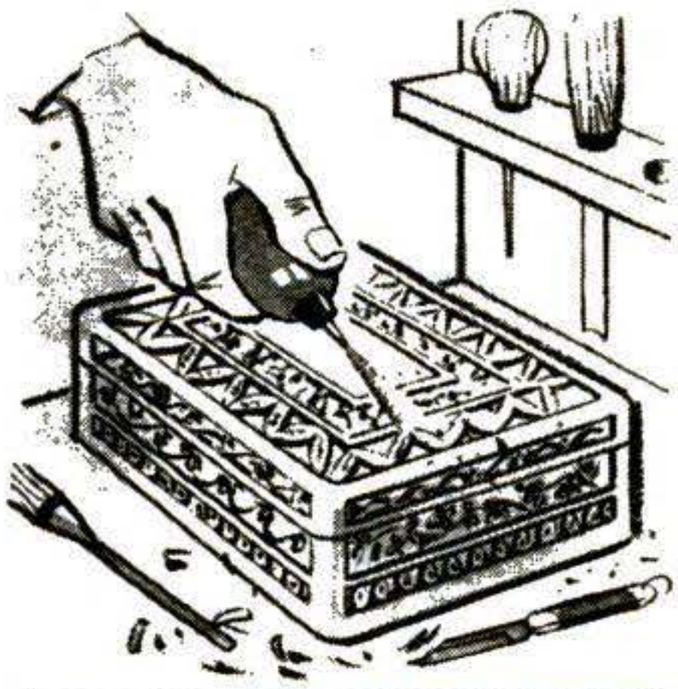
CLEANING WINDSHIELDS



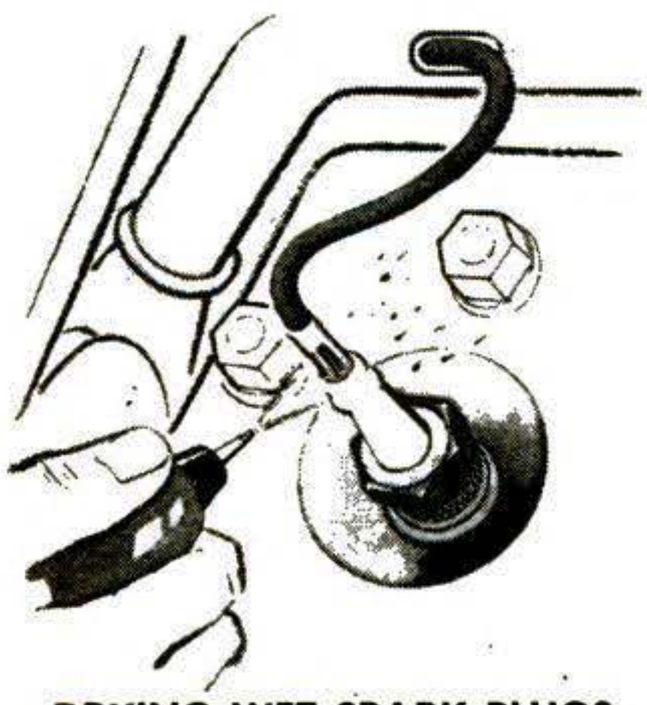
JET-CLEANING SMALL MECHANISMS



AIR-DRYING SMALL PARTS



BLOWING OUT SANDING DUST



DRYING WET SPARK PLUGS

DUSTING INSECTICIDES

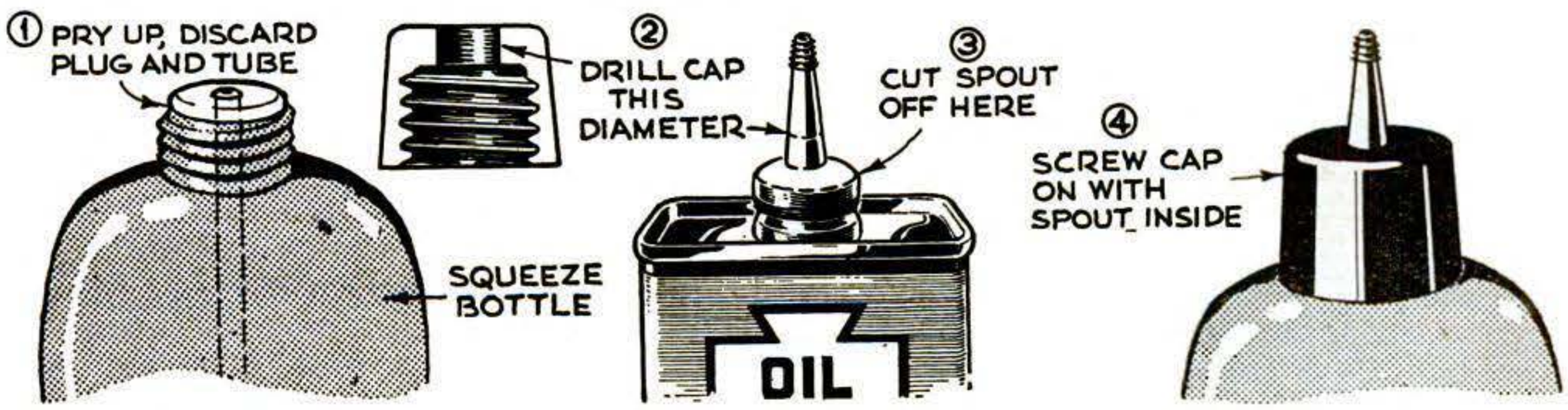
Squeezing Extra Service from Plastic Bottles

Better grab those empty plastic squeeze containers before they're thrown out. They'll come in handy in the workshop and around the car.

EMPTY squeeze bottles have a lot of utility left in them. They make handy little bellows for puffing dust, filings or abrasive grains out of inaccessible places and delicate mechanisms. The air from them is drier than breath and less likely to cause rusting.

Made of polyethylene, these bottles come in both dispenser and sprayer types. The latter has a tube reaching to the bottom and will spray upward. The dispenser bottles have simply a small hole at the top and must be inverted to squeeze out the contents. Cutting off the tube converts the spray type into a dispenser.

Under the cap of these bottles is a small plug that fits like a cork and can be pried out with a knife for refilling. If the jet or spray is coarser than desired, you can make the orifice smaller by touching the plastic around it with a wire heated in a match flame. Petroleum, turpentine and lubricating oil won't hurt polyethylene at temperatures below 158° F.



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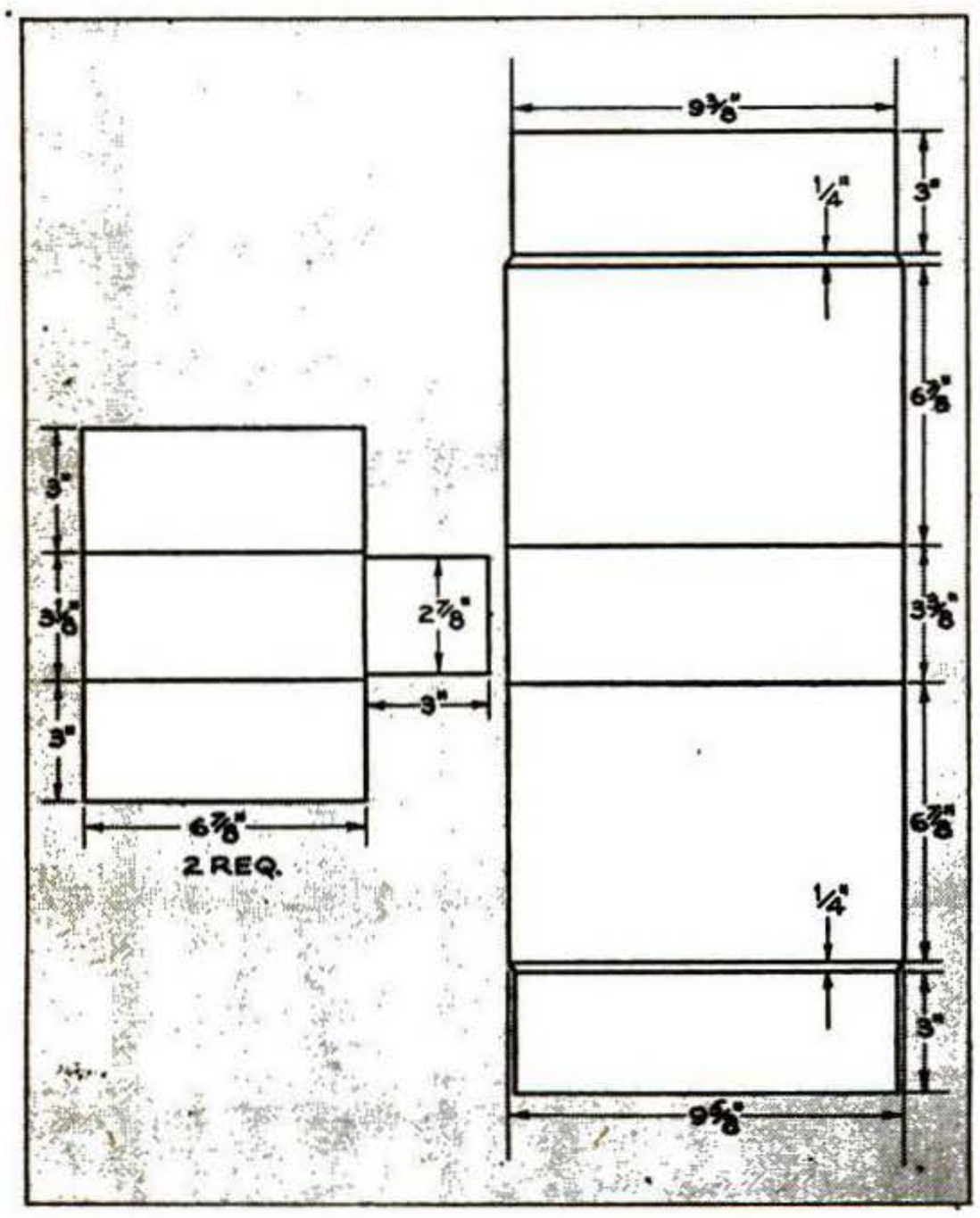
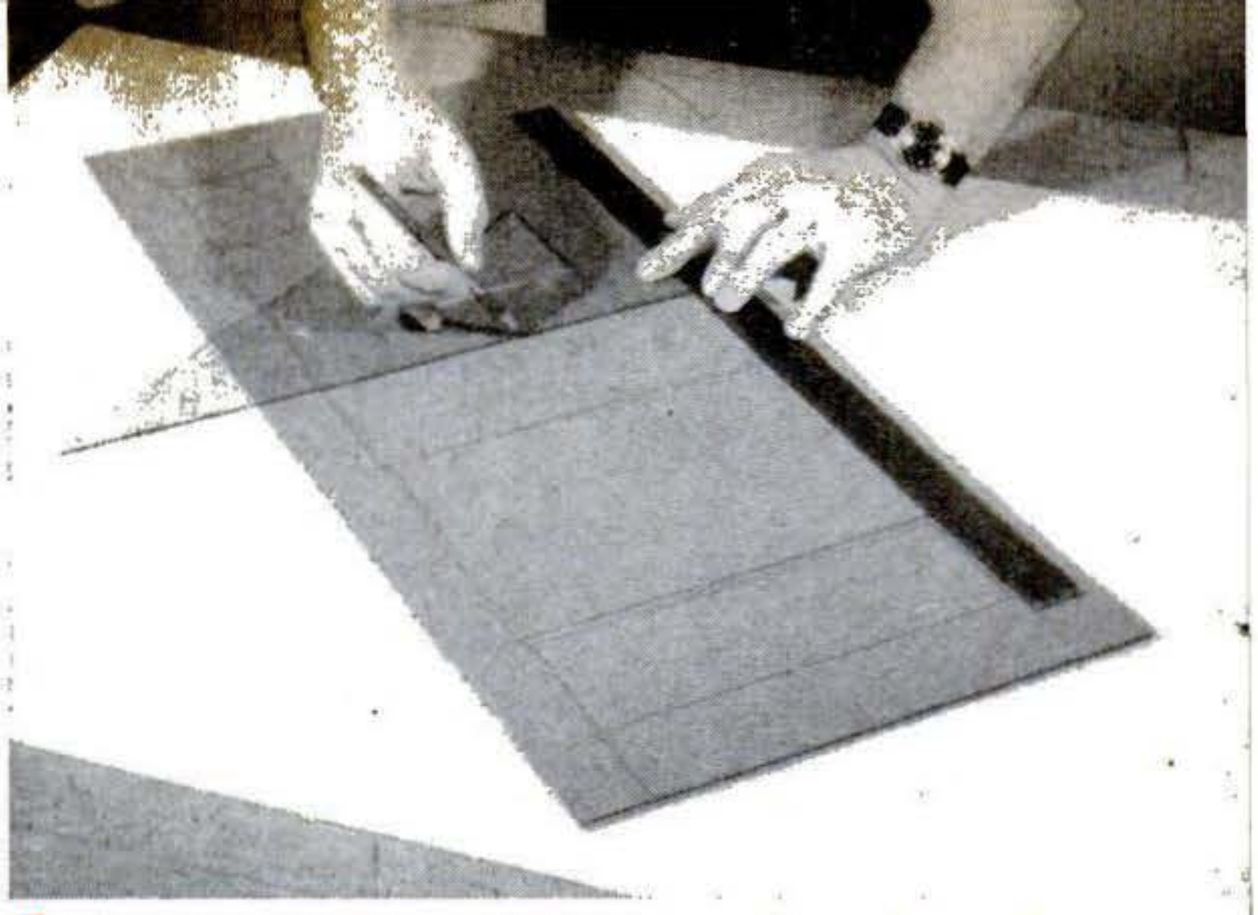
PSM File Keeps Copies at Your Fingertips

Your back issues won't get lost, strayed or dog-eared if you keep them in these easy-to-make corrugated-board cartons.

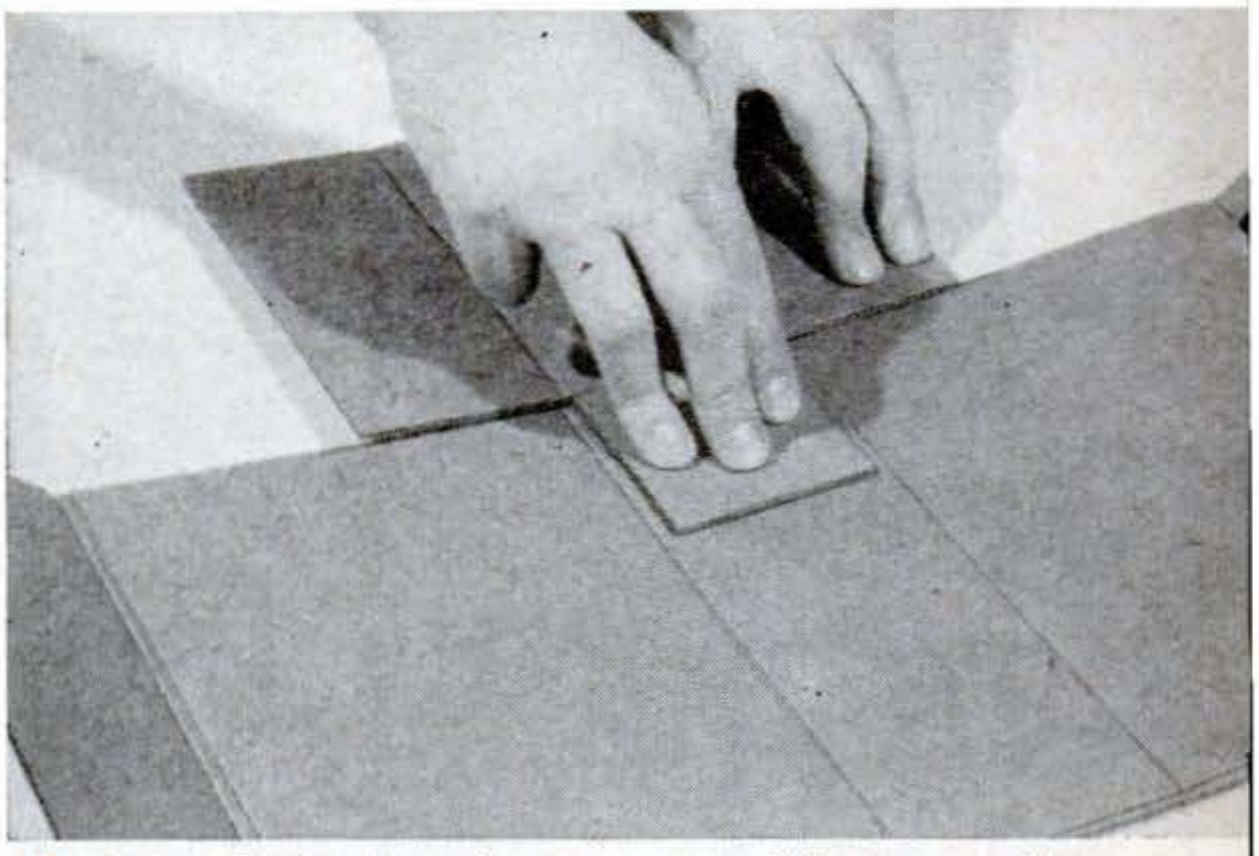
YOU can quickly look up plans, articles and other information in POPULAR SCIENCE MONTHLY if you keep your back copies in a file like this. Made of ordinary corrugated cardboard, each box holds six issues and has a place on the side for listing stories you may want to find later. They're sturdy, handsome and you can mass-produce a bunch of them in an evening. The boxes were designed by noted cardboard engineer Richard E. Paige (PSM, Mar. '52, p. 165), who shows you in pictures how to put one together.

Next month, PSM will publish a full year's index that you can file right along with your issues for quick reference.

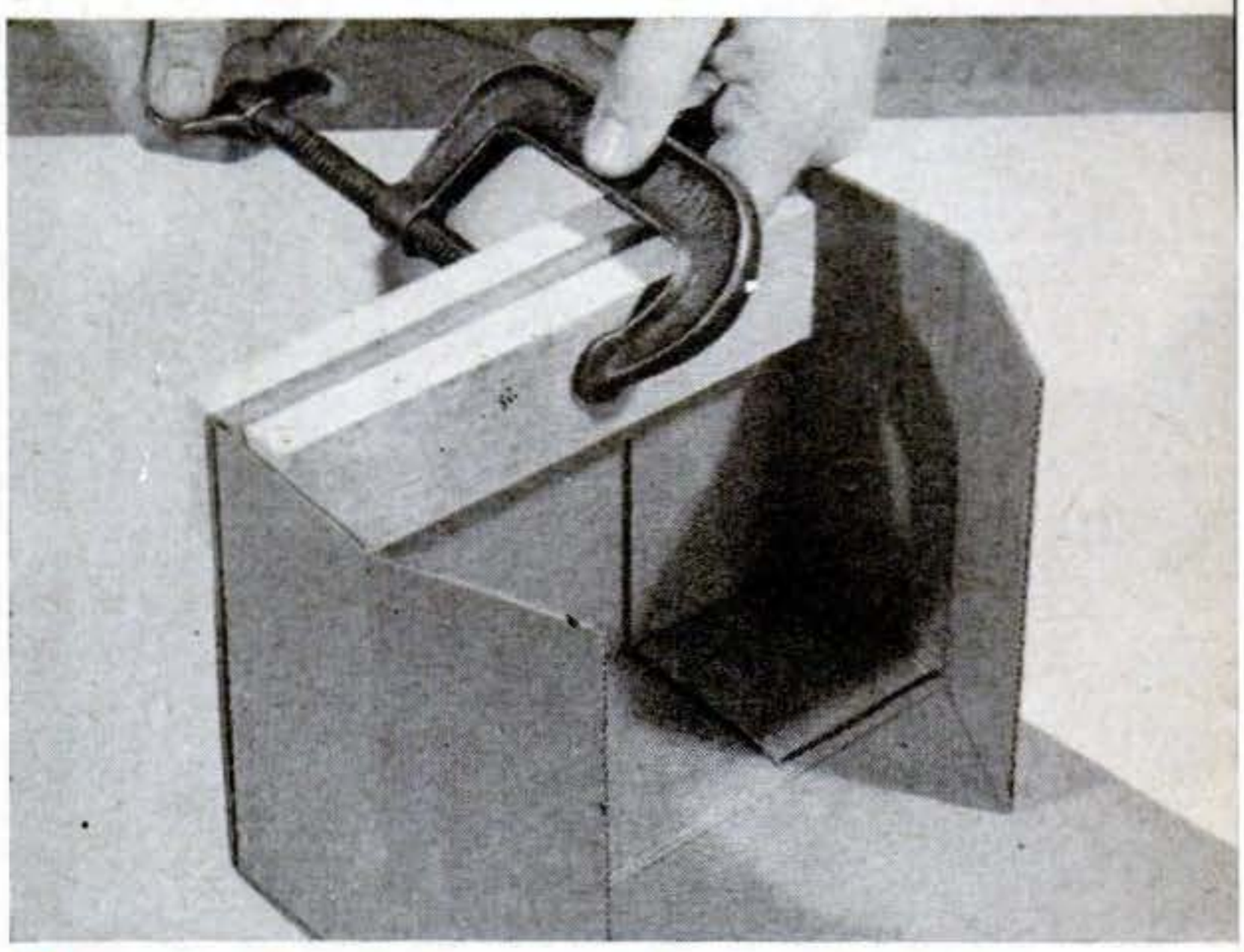




1 LAY OUT PATTERN of file on cardboard panel cut from large box. Use soft pencil to avoid gouging face. Fold-lines should run across corrugations for greatest strength.



4 SMALL TABS that form top and bottom of file are cut out and glued on next. Use a quick-drying household cement and press pieces firmly together for several minutes.



7 BEND TOP AND BOTTOM PIECES UP, then fold glued side flap over these. Use blocks and C-clamp to hold flap while glue sets. Spread glue on other flap and repeat process.

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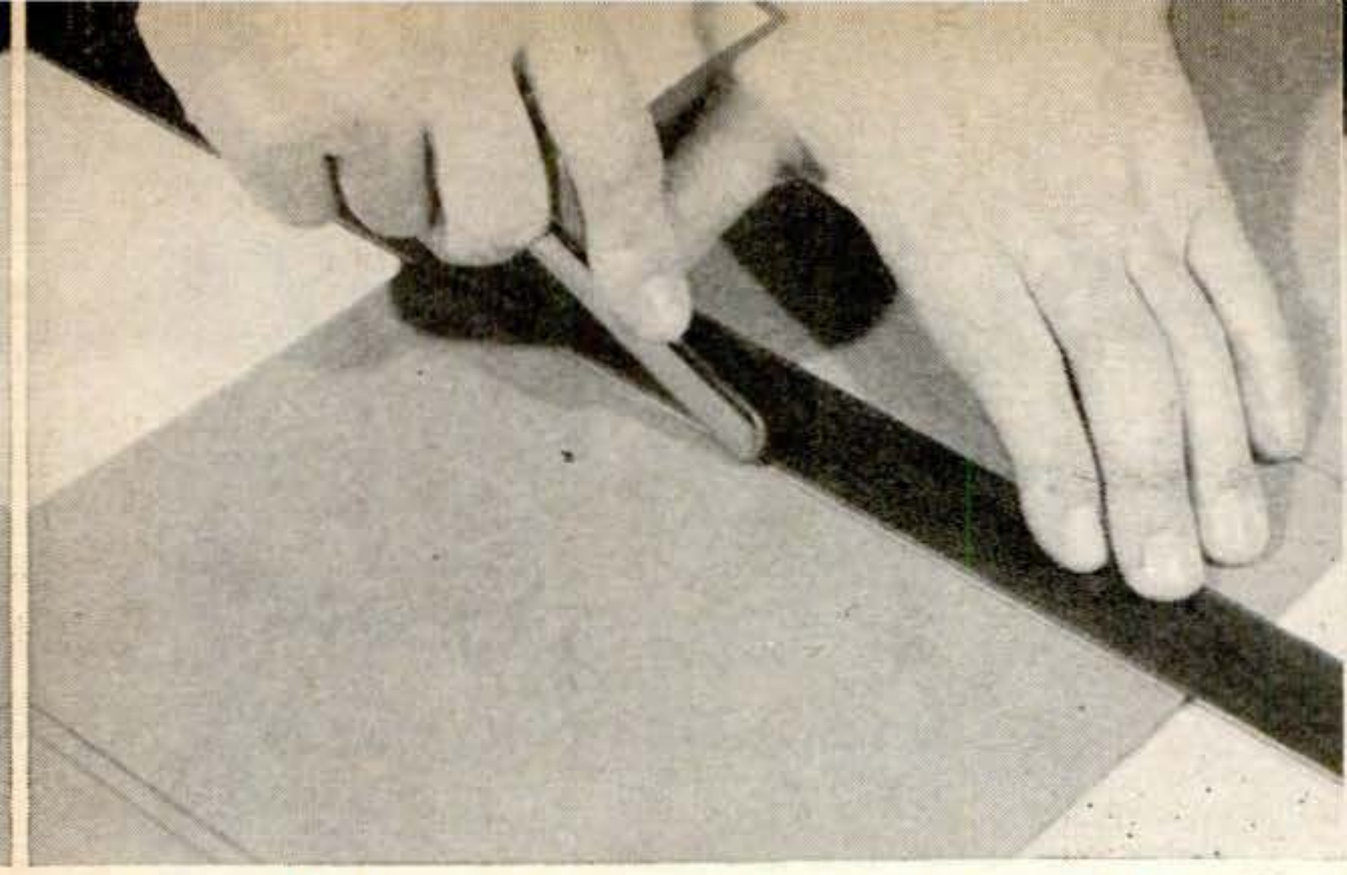
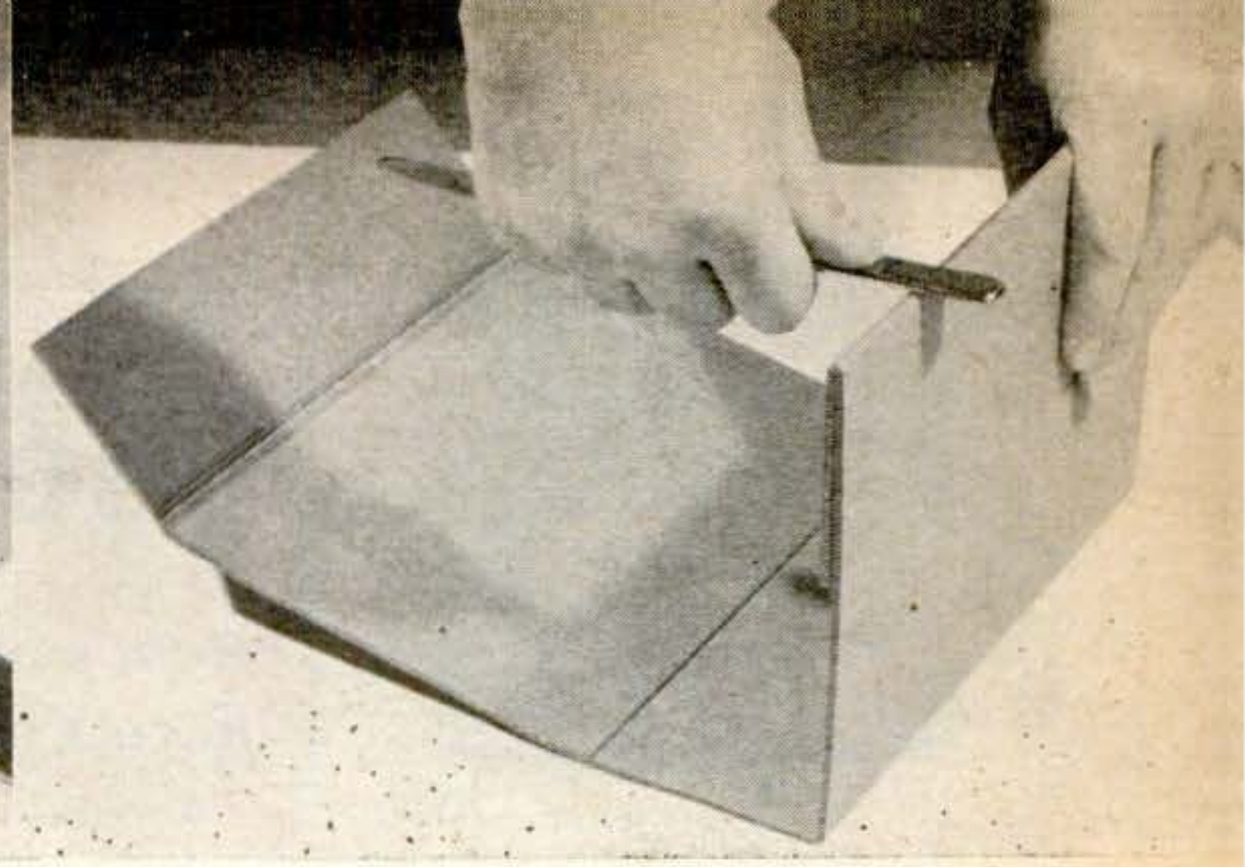
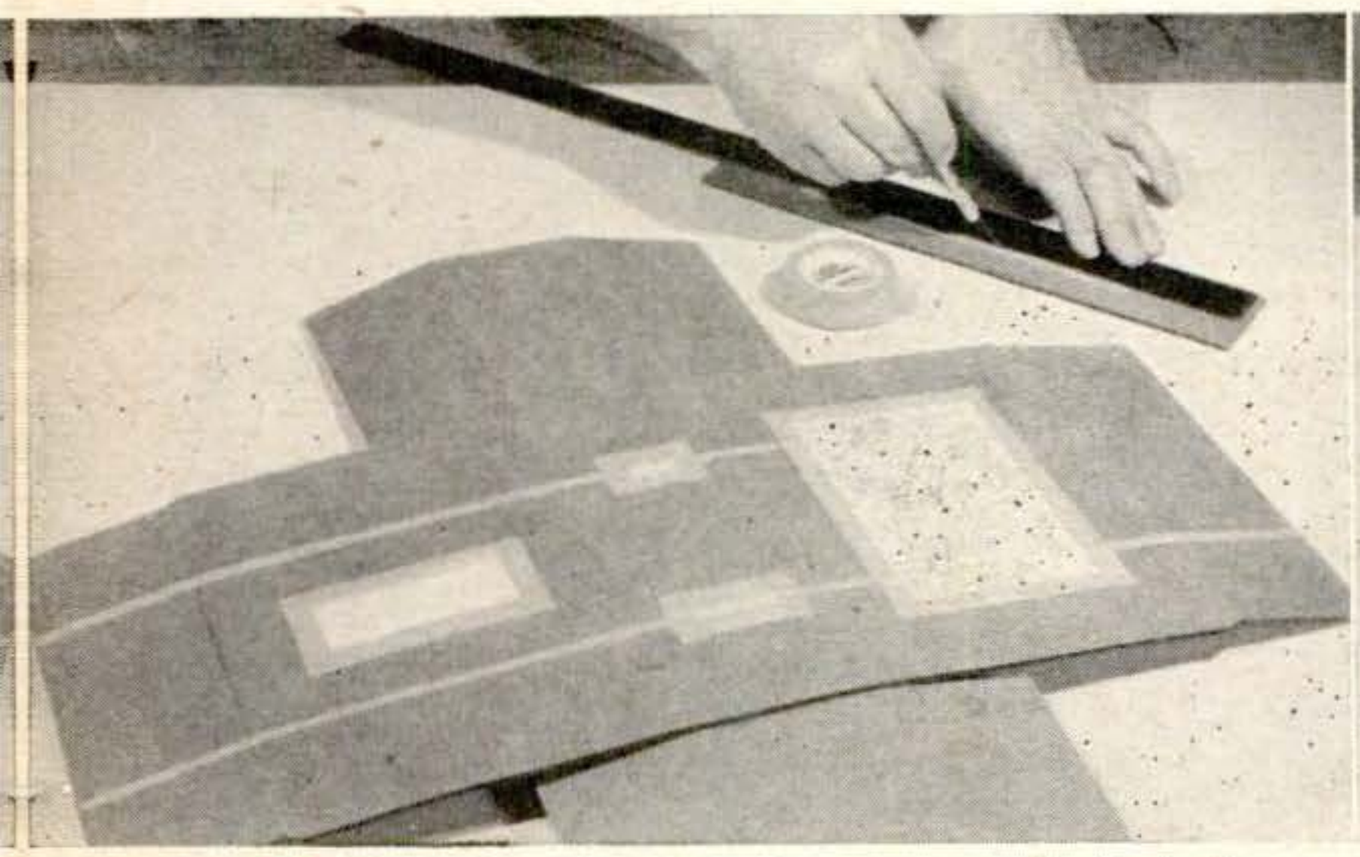


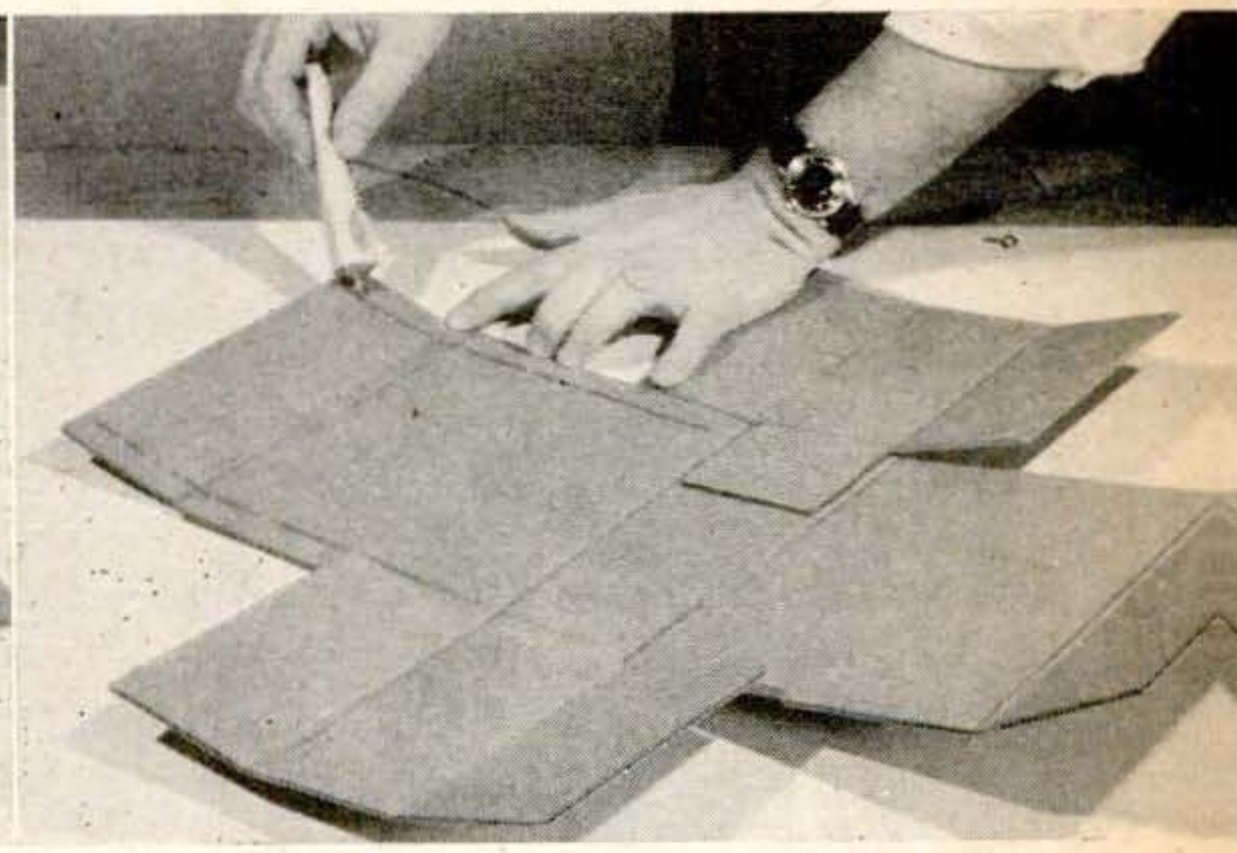
2 SCORE FOLD-LINES by running knife handle or other smooth, blunt tool back and forth along straightedge. This dents cardboard, makes it easy to bend in a straight line.



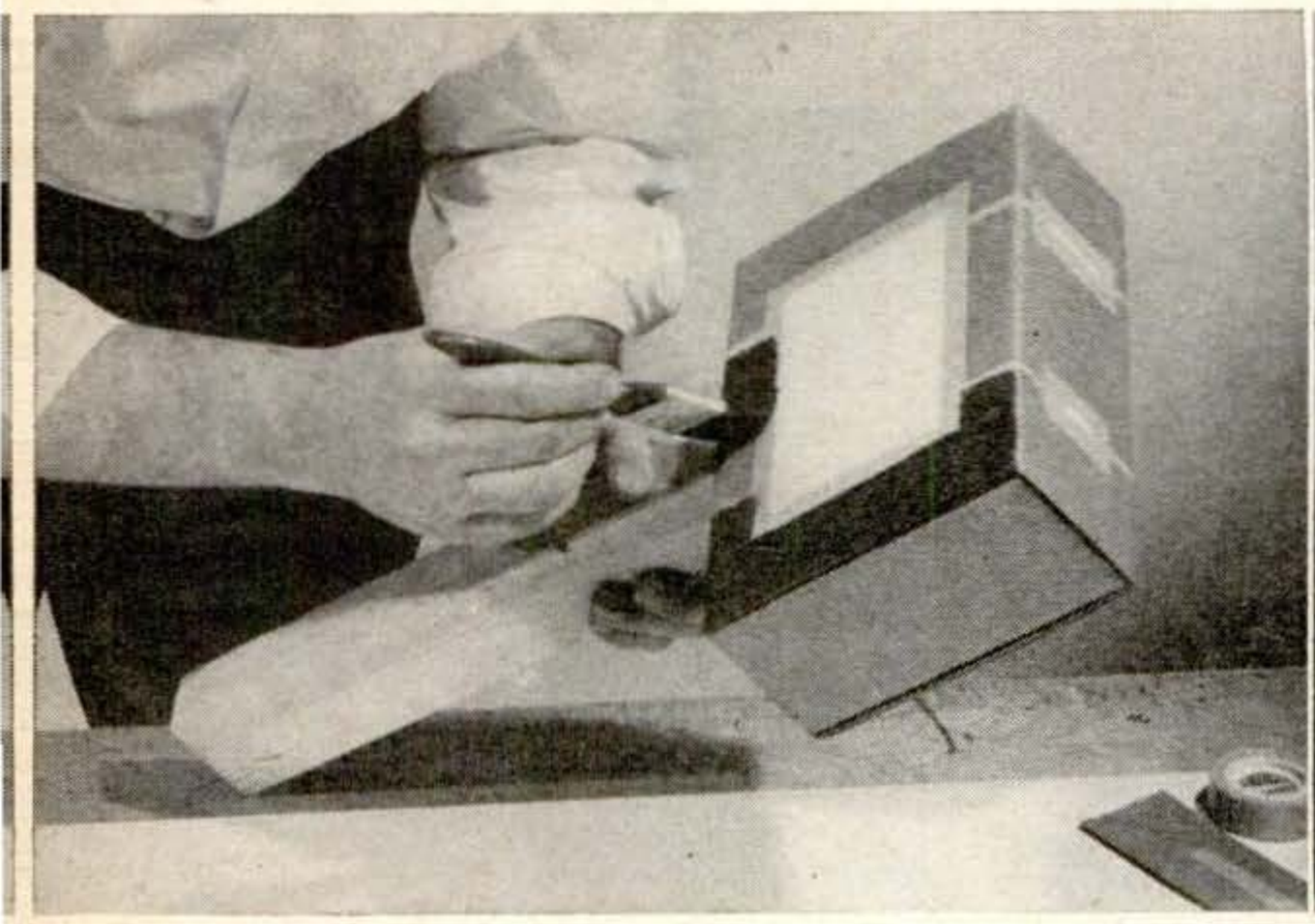
3 BEND CARDBOARD along score lines by holding each section flat and pulling up gently on the one next to it. Then use knife handle to smooth edges where flaps bend inward.



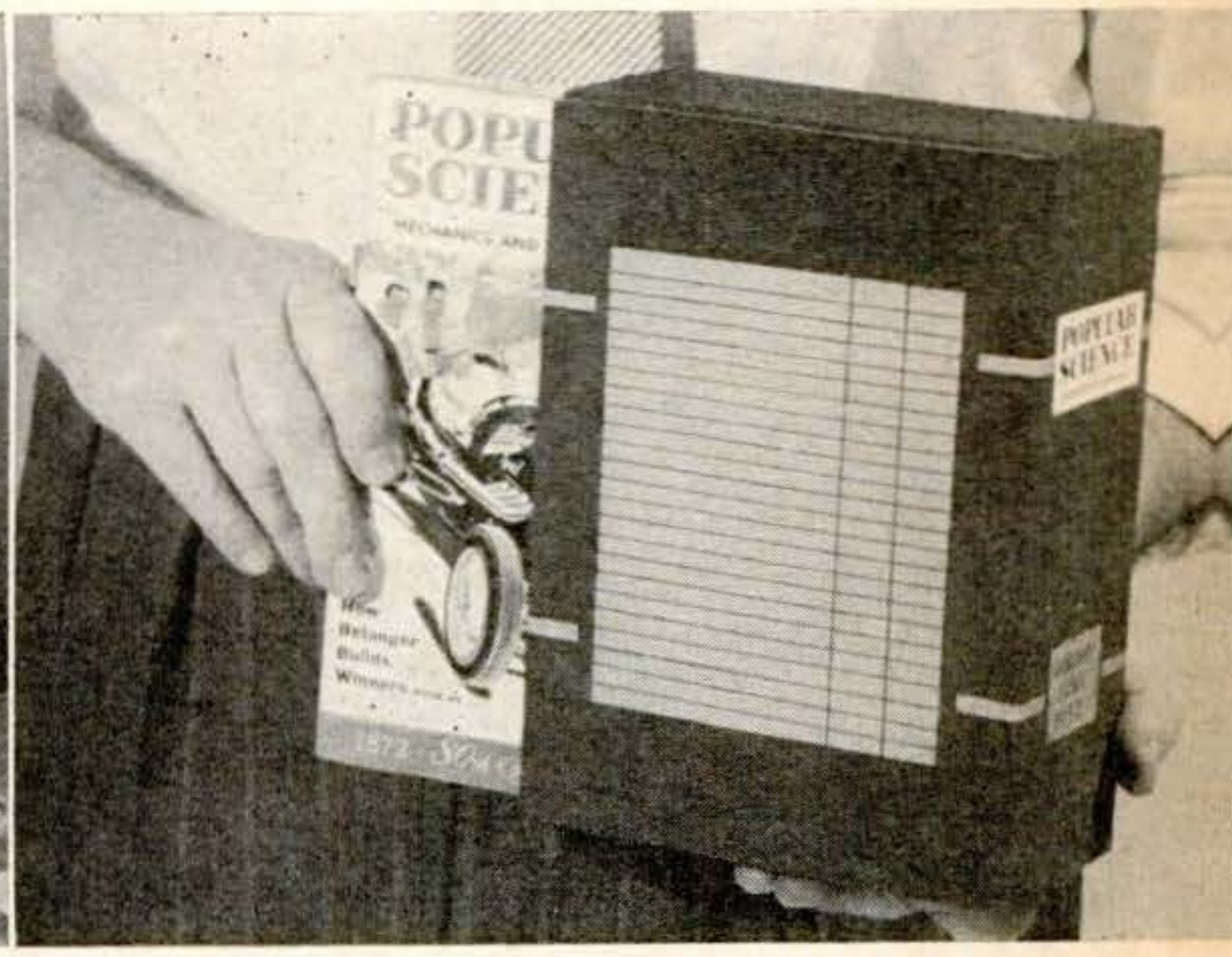
5 PLACES FOR LABELS are masked before painting by taping on pieces of paper that are later removed. Narrow bands around box are made with ¼″ strips of masking tape.



6 SPREAD BEAD OF GLUE along both edges of flap. Cover only one flap at a time and keep glue 1″ in from edges so it won't squeeze out of seam when box is assembled.



8 RUBBER-BASE PAINT is a quick, durable finish. Short two-by-three wedged into file is convenient handle so you can paint all sides easily. When dry, strip off tape.



9 FINISHED FILE has index on side for listing articles you want to refer to. Large label on other side is cut from PSM cover. Small labels can be hand-lettered.

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What You Should Know About Magnetos

When your power mower or outboard quits, here's how you can quickly find the cause.

By J. W. Rocke

IF YOU own a power mower, outboard motor, garden tractor or some other gasoline engine, the chances are it has a magneto. This is the little juice-maker that kicks the spark plug. Unlike a battery ignition system, a magneto generates its own current by the relative motion between a set of magnets and a coil of wire and steps up the juice to high voltage. You just give it a push and it's on its own.

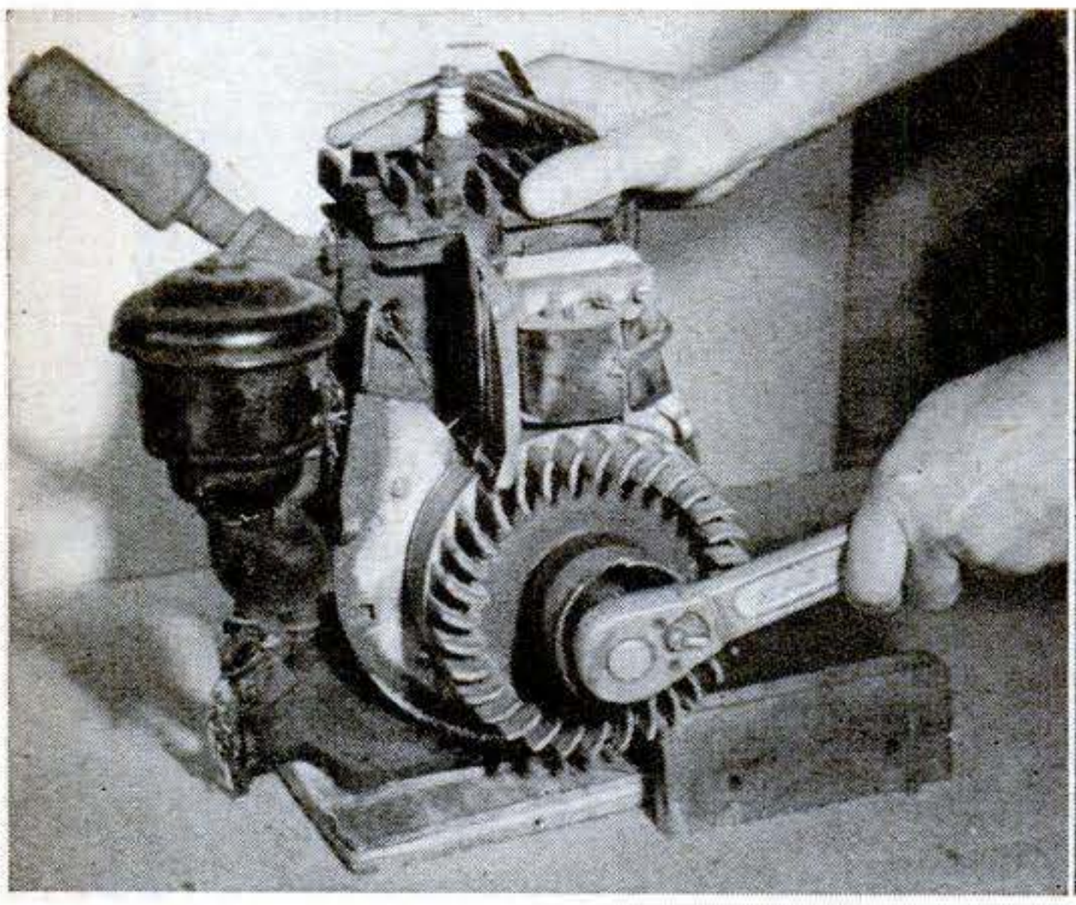
Magnetos are a tough, tireless breed that run for years and wear like the iron they're made of. But when they do kick up, there's no need to dry-dock your boat or go back to mowing the lawn by hand. Most troubles are a matter of adjustments that you can make yourself. Those you can't can be handled by any garage with standard auto-ignition test equipment. A defective part is a couple of bucks and a half-hour replacement job to put you back in business.

There are many types of magnetos, but the parts are always the same. The coil can remain stationary and the magnets move, or the magnets remain stationary and the coil move. Or both may remain stationary with the relative motion provided by a soft iron armature moving between them.

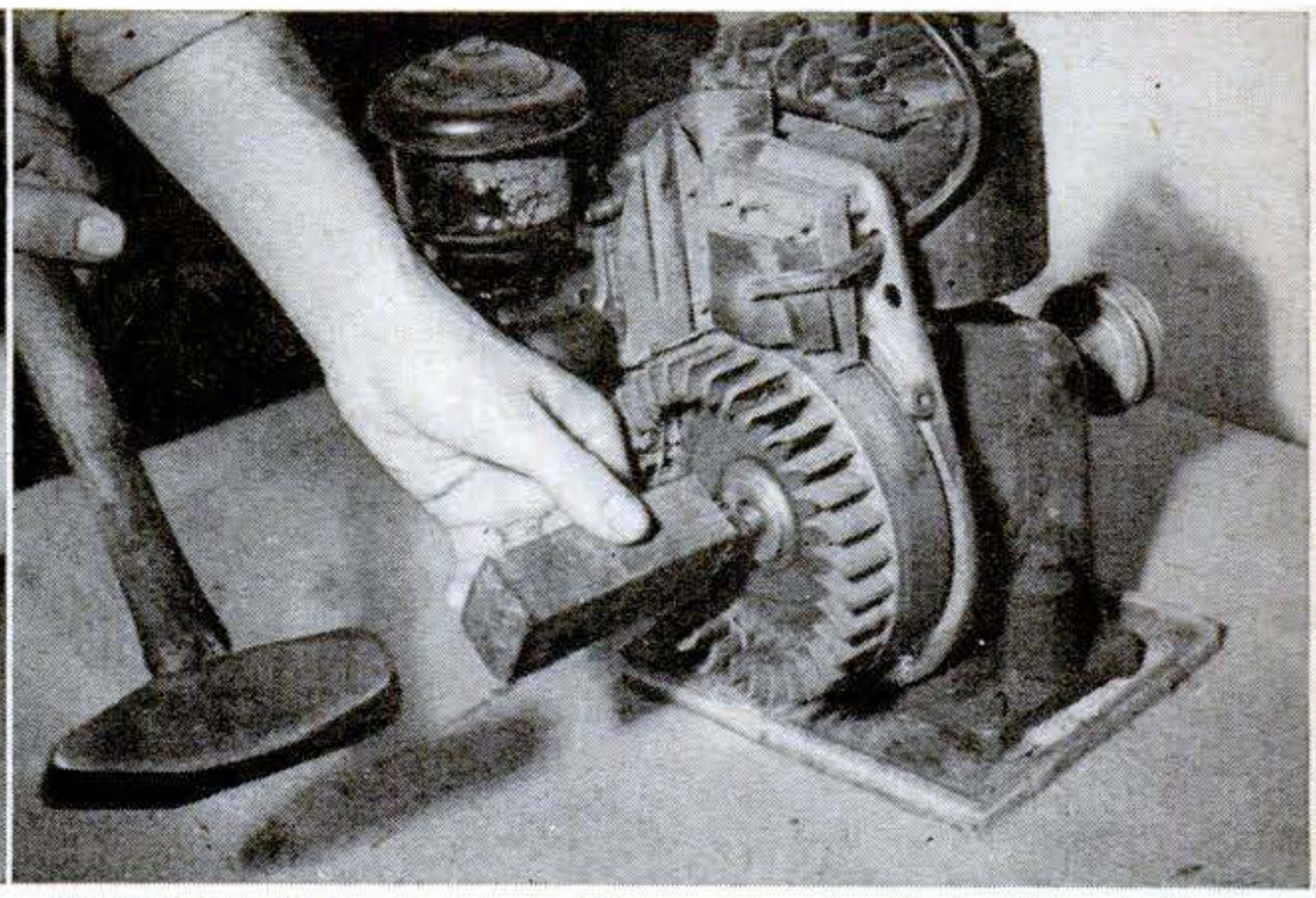
The photos show a typical small-engine magneto where the magnets, set into the rim of a flywheel, are spun around a fixed coil by the crankshaft.

Breaker points are critical. These are electrical contacts that are opened by a cam on the crankshaft every time the flywheel rotates, creating the electrical snap that fires the spark. If the points open too early or too late, the current in the coil will be below peak strength and give a weak spark. This is more important in a magneto than in a battery ignition system because of the comparatively low primary voltage you have to work with. If you don't grab it while it's hot, you lose it.

You can't do much about basic timing, which is determined by the position of the cam on the shaft and generally isn't adjustable. But the spacing of the points also affects timing and should be carefully set to the specified clearance.



FLYWHEEL MUST BE REMOVED to reach magneto parts. Wedge flywheel against block to prevent turning and loosen retaining nut on shaft. Some nuts may have left-hand thread.



TAPPING CRANKSHAFT this way may free the taper-mounted flywheel, though a gear puller is surer. Never drive wedges between flywheel and mounting plate as plate may crack.

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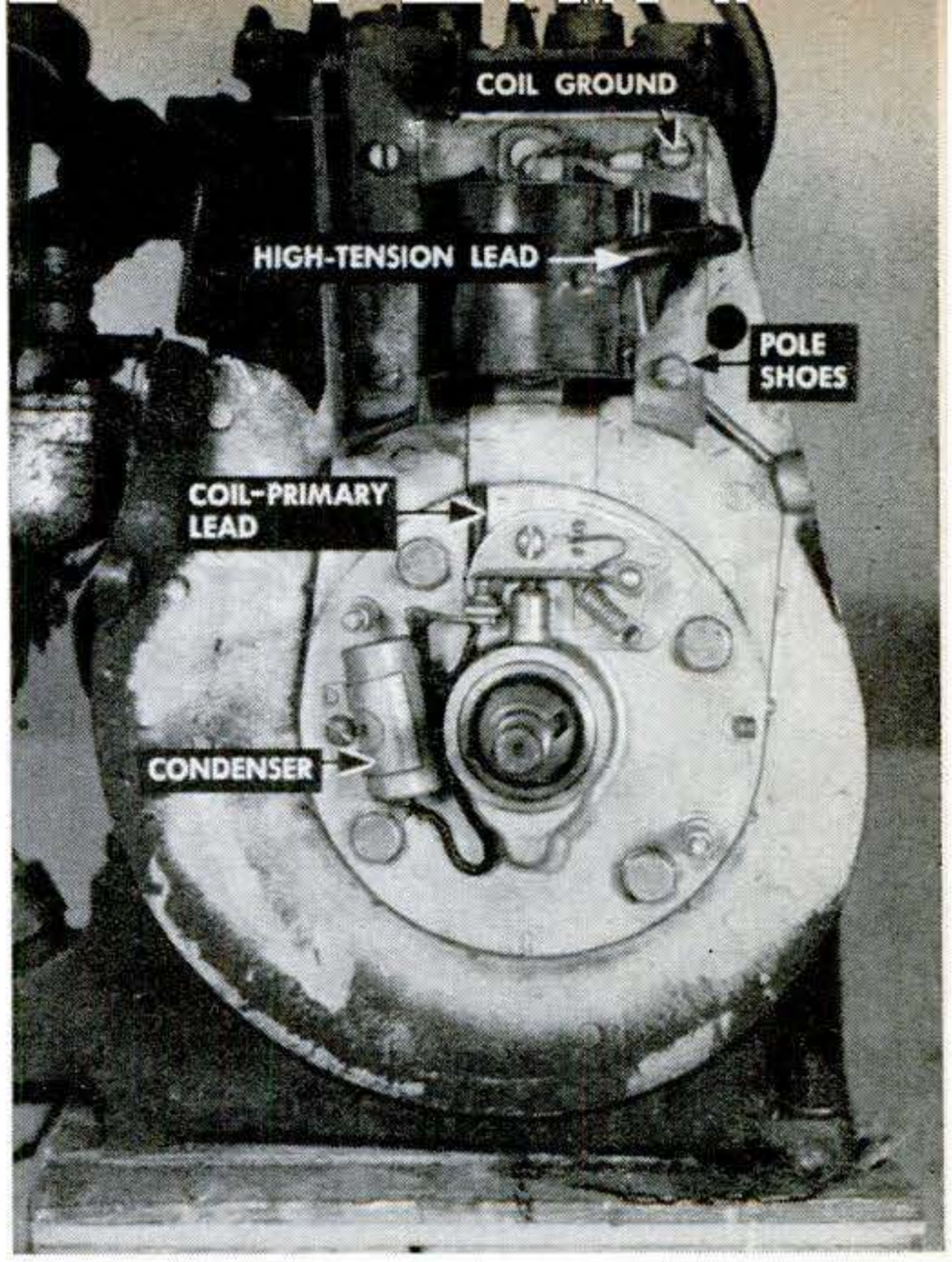
Excessive spacing, or a weak spring that doesn't close the points in time for the next spark, can also cause intermittent misfiring at high speeds. This is especially important on high-performance jobs like outboards and can mean the difference between leading the pack or eating their spray.

Another sure way to miss the Sunday motorboat outing is with points that have become gummed with oil and grease or pitted and carbonized from arcing. Both cause poor contact of the points, preventing proper build-up of current in the coil. Result: weak spark, no start, and you're left waiting at the dock.

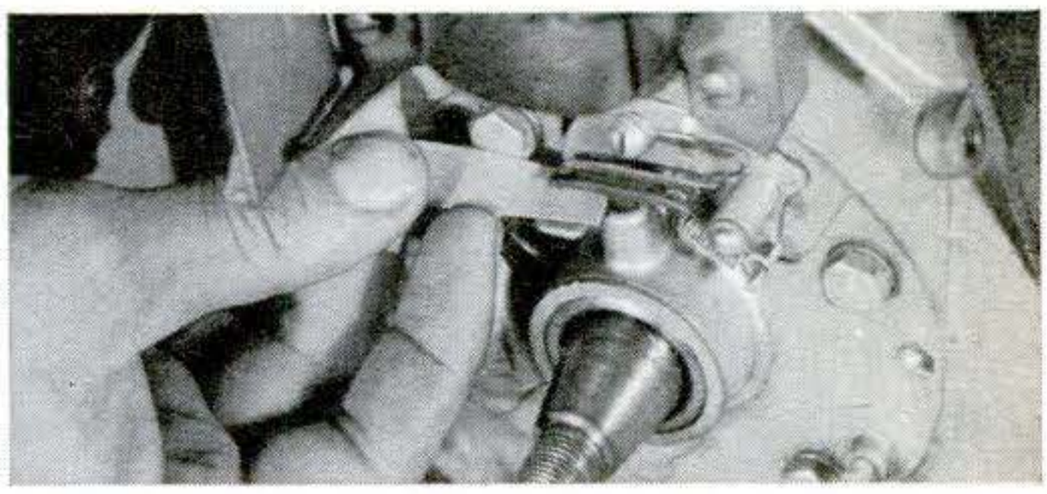
Clean the points as shown in the photos. Slight pitting can be smoothed down with fine sandpaper, but don't fuss around with points that are badly scarred. These are hard to hone by hand without upsetting their alignment and spoiling good contact. If they're bad, buy a new set.

Use the right condenser. The condenser does two things for you. Connected in parallel with the breaker points, it absorbs the electrical surge created when the points open, preventing arcing that would burn and pit them. It also reverses the current flow, sending the charge back to the coil with the smack that gives the spark muscle.

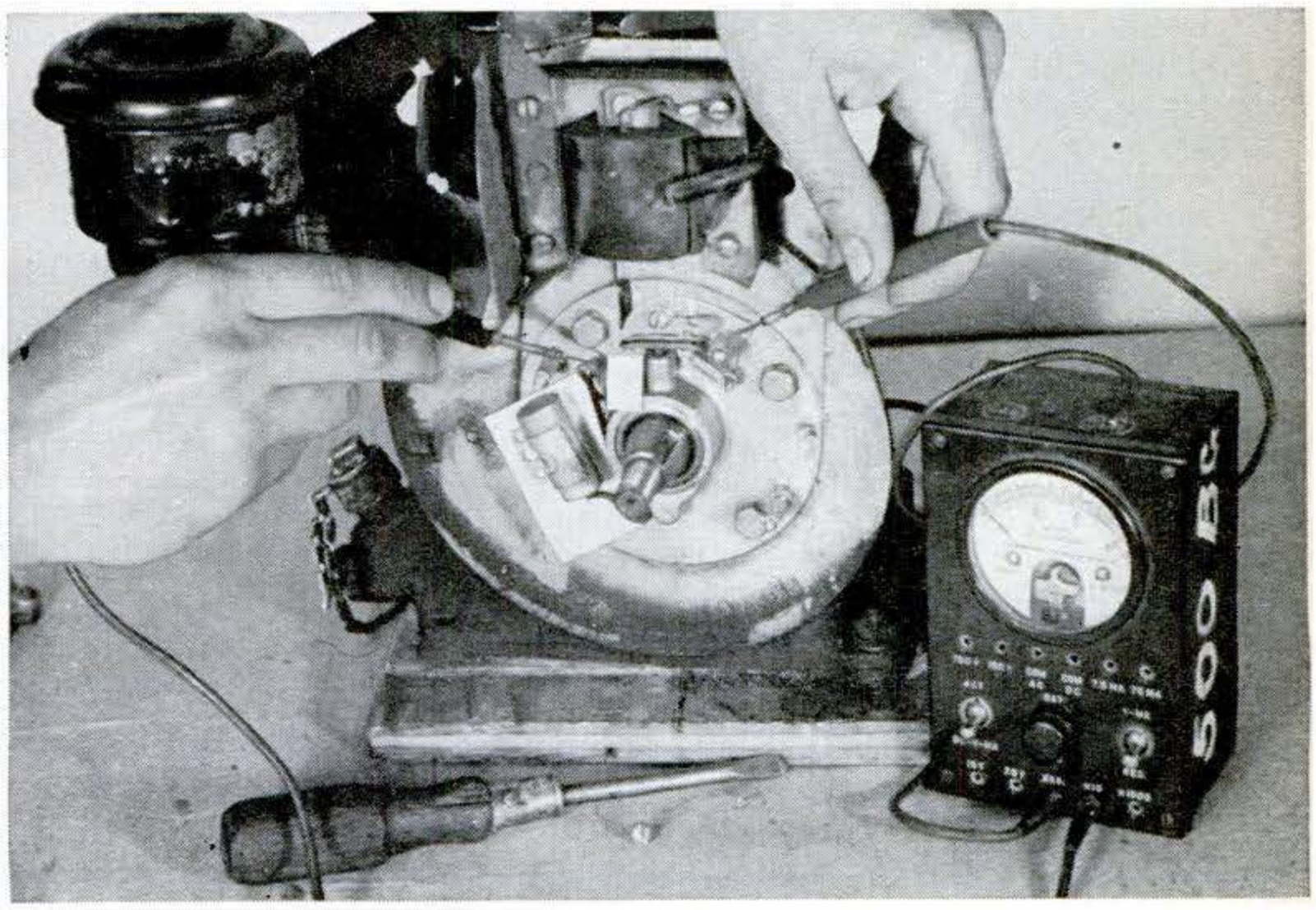
Any leakage in the condenser or loose connections causing high resistance to the current will rob the spark, and you won't get enough juice to light up a firefly. You can tighten the connection with a screwdriver, but the condenser itself requires special test equipment. If everything else checks



BREAKER POINTS are actuated by cam on crankshaft that pushes out plunger and opens points each time shaft rotates. Coil on this engine is mounted above flywheel.



SLIGHTLY WORN POINTS can be smoothed by drawing fine sandpaper between faces. Avoid filing, which roughens faces, causing poor contact. Replace badly pitted points.



BURNED-OUT coil primary can be detected with ohmmeter, as here, or bulb and battery. Block breaker points open with cardboard and connect test leads across point terminals. Insulate condenser case from mounting plate. To check secondary, connect high-range ohmmeter between plug and ground. Low reading indicates a short.

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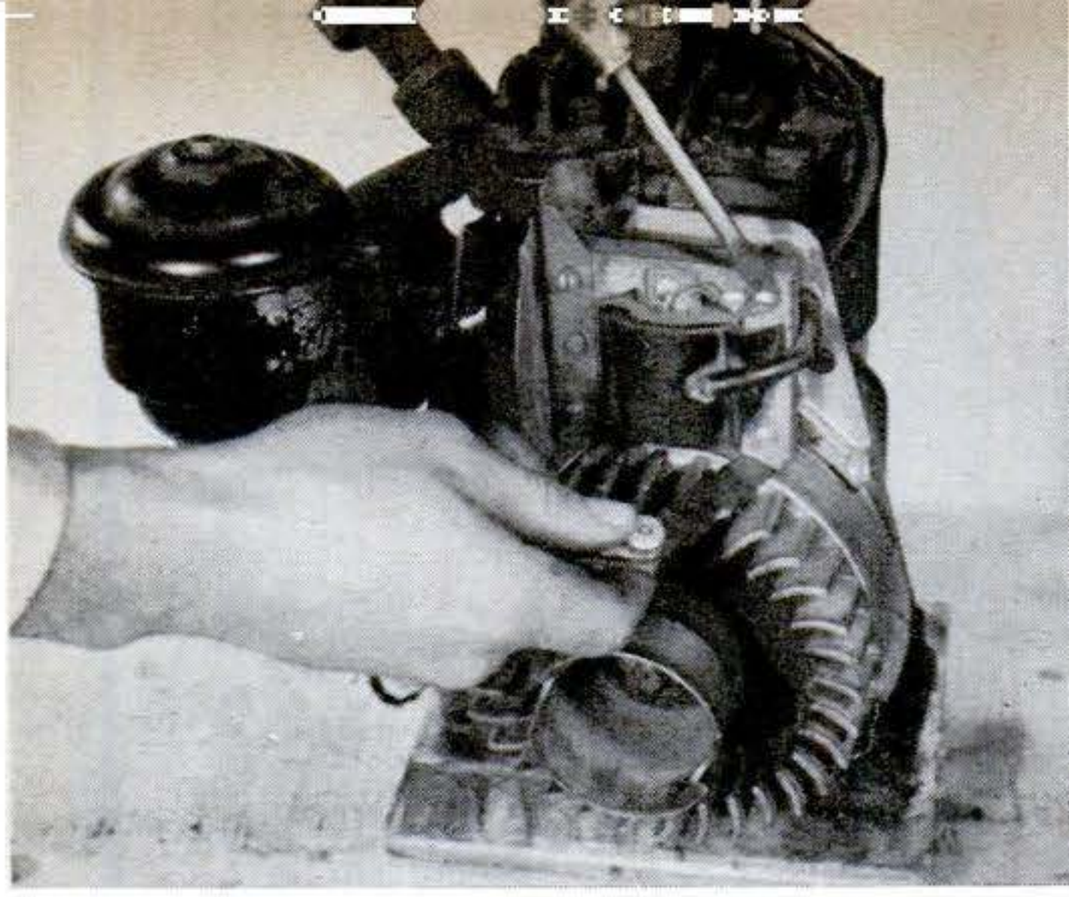
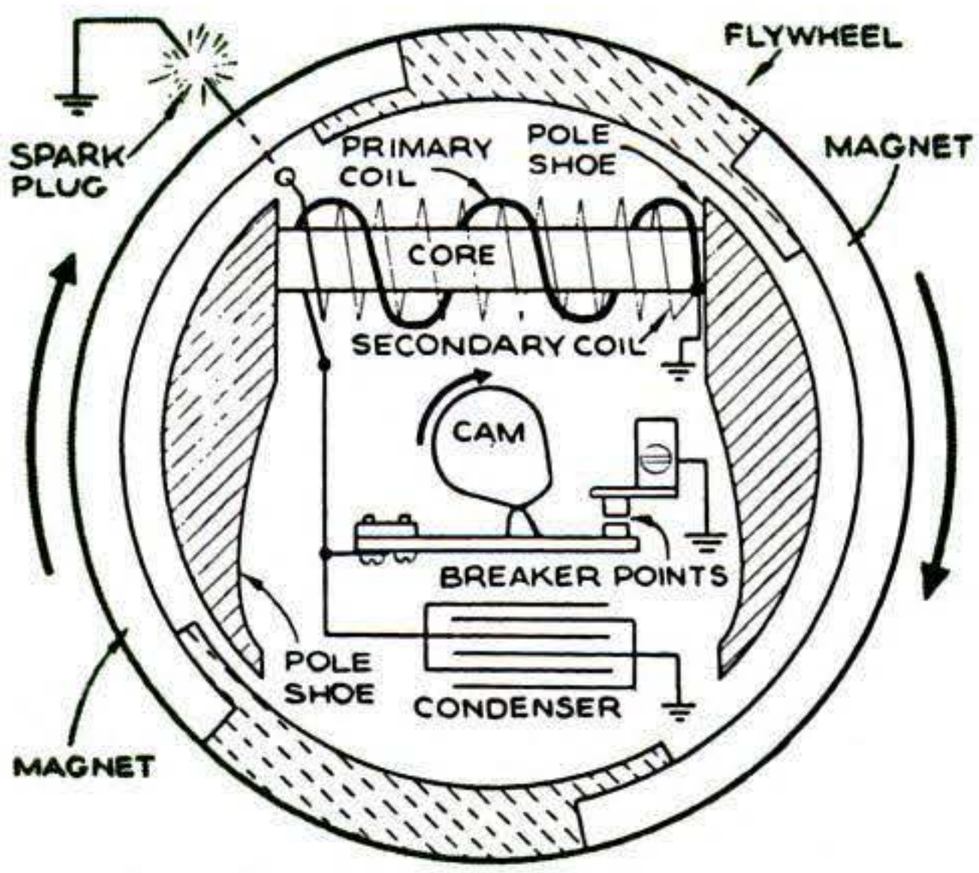


AIR GAP between coil pole shoes and flywheel should be just enough to prevent rubbing but not more than .012". Check with thickness gauge. Too-wide gap weakens magnetic field.

GREASE OR CARBON on breaker points prevents good contact, weakens current. Clean points with brush soaked in carbon tetrachloride, then draw hard paper between faces.

How a Flywheel Magneto Works



As MAGNETS rotate around coil pole shoes, low-voltage current is generated in coil primary, consisting of few turns of coarse wire. Magnetic field is strongest when magnets are directly opposite pole shoes, but due to lag, current does not reach peak strength until magnets have passed shoes. At point of peak strength, cam on crankshaft opens breaker points, as shown above, creating current surge as primary circuit starts to break down. Current can no longer flow through breaker points and is now forced into condenser, connected in parallel with points. Condenser absorbs surge, then discharges back into coil, causing complete and final collapse of primary circuit. This induces high-voltage current in coil's secondary winding, made up of many turns of very fine wire. As current reaches peak strength —20,000 to 25,000 volts—it jumps gap in spark plug, creating spark that fires fuel charge. By this time, magnets have rotated past coil pole shoes again, building up another charge in primary, and the whole cycle is repeated.

out, it's worth a trip to a repair shop. If it proves at all weak or leaky, chuck it.

Get the right replacement, too. If the Gotrocks are coming to dinner and the lawn needs a haircut badly, you can probably get by with an auto-ignition condenser as an emergency substitute. But get the right one as soon as possible. A condenser of the wrong value can cause a weak spark and burning of the points.

Checking the coil. If Junior comes sputtering in on his motor scooter claiming it worked fine when he started and then suddenly conked out, there's a 50-50 chance that the coil's at fault. The other 50 is a bad condenser, which may show similar symptoms.

Coils sometimes check okay when they're cold, then fail after warming up due to expansion that produces an open circuit. For this reason, coils should be warmed up before testing, or you'll be as fooled as Junior.

You can check the primary of the coil with an ohmmeter, as shown in the photo, or by connecting a battery and bulb in series with the windings. Failure of the bulb to light or no response on the meter indicates that the coil is burned out and must be replaced.

The secondary, due to its high resistance, can be checked only by a high-range ohmmeter. If you don't have one, throw the engine in the car and take a run down to Joe's garage. He'll check it in a couple of minutes.

Look at the spark plugs. These, while not a part of the magneto itself, are another major source of trouble and should be checked at the same time.

Fouled plugs should be thoroughly cleaned and their points gapped to specifications. Badly worn, burned or pitted plugs

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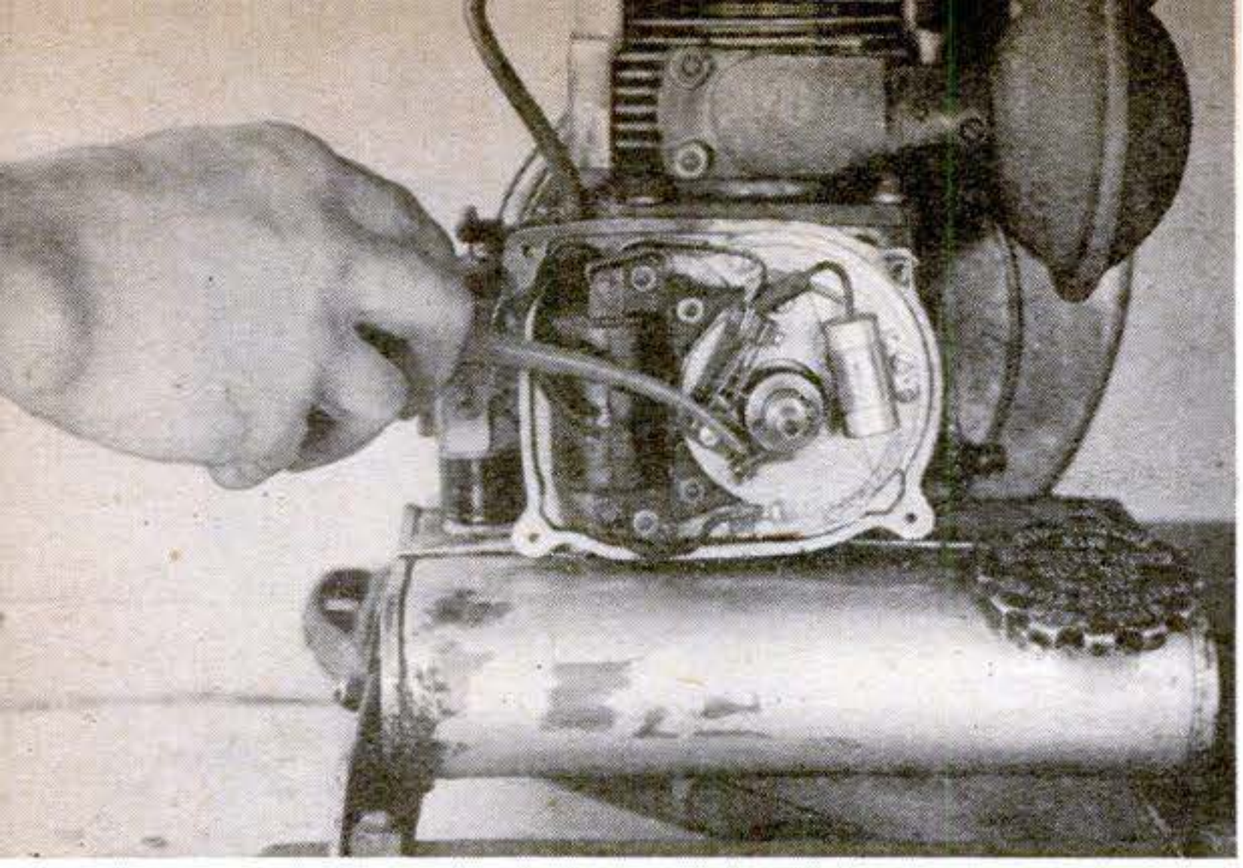
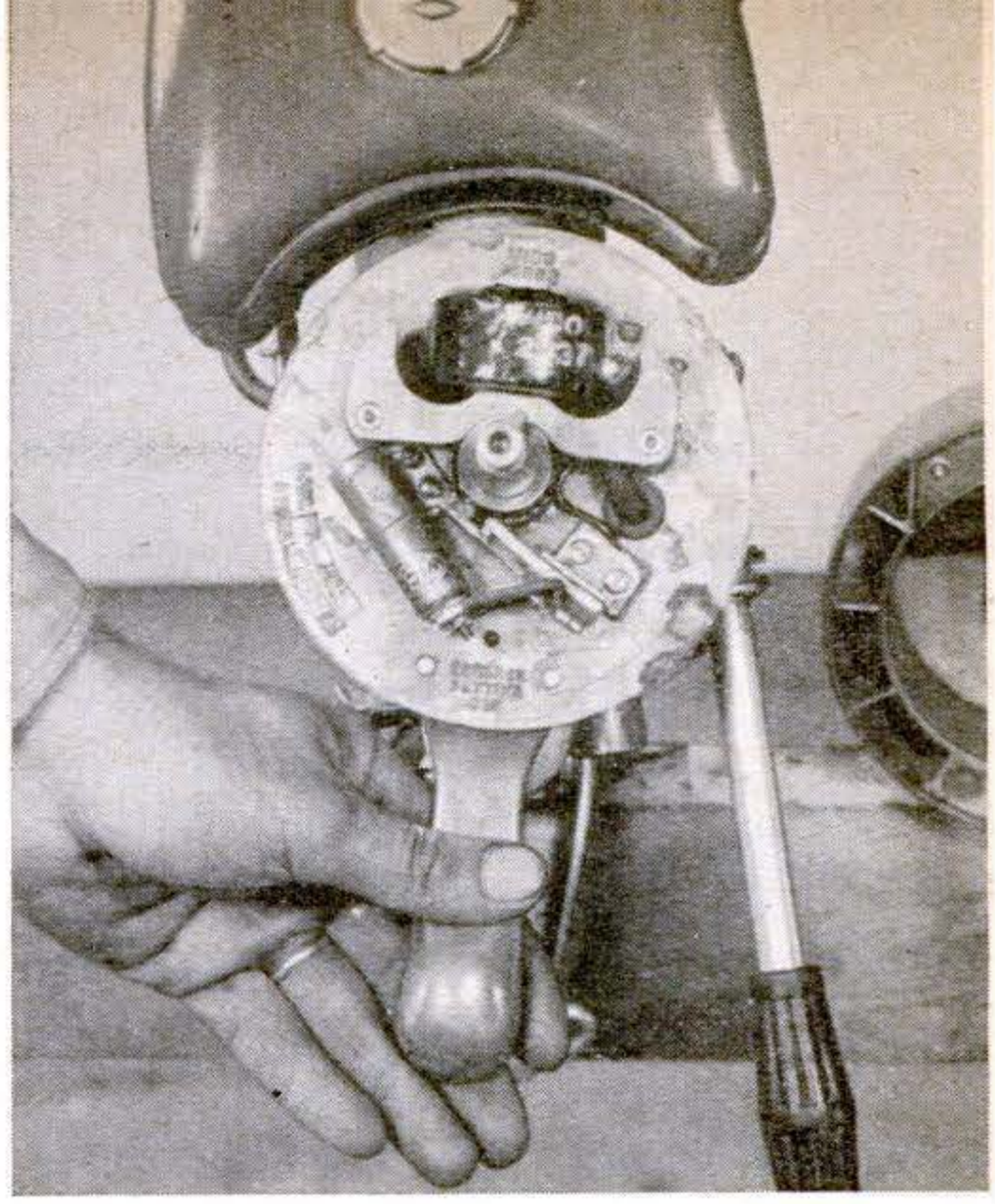


FELT WICK, saturated with oil, is used in some magnetos to lubricate breaker-point cam. This should be kept oiled, but apply only one drop. Excess oil may cause oxidation of points.

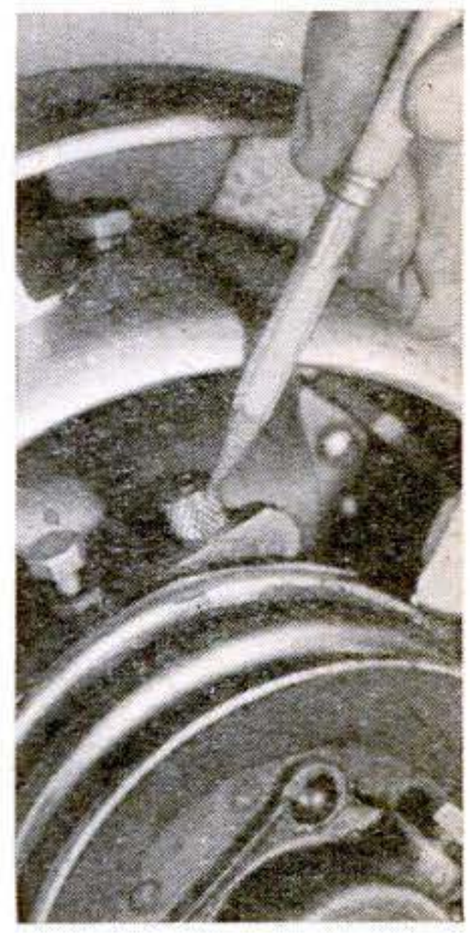
should be replaced. Since you need only one or two, frequent replacement won't break the bank and will help your engine.

Don't abuse the magnets. You can do a lot of worrying about the magnets, but the main thing to guard against is accidental demagnetizing. Handle the flywheel carefully when you remove it from the magneto, and avoid sharp blows with a hammer, excessive heating or passing them near a large current-carrying coil.

Magnets can also lose strength through age. Proper testing requires special equipment, but you can get a rough idea by simply seeing what the magnets will hold. A good healthy set should easily pick up several small wrenches. If they won't, they should be returned to the manufacturer for remagnetizing. END



SPEED is controlled on many outboards by moving handle that advances or retards spark. Heat-resistant grease should be put on breaker-point block that rides cam.



GOVERNOR, used on some engines, is spring-loaded cam that keeps points from operating above set speed. Spring is adjusted by knurled nut (pencil). Other nut adjusts point gap.

MAGNETOS

TROUBLE	POSSIBLE CAUSE	REMEDY
Weak spark	Weak magnets	Remagnetize
	Weak coil	Replace
	Leaking condenser	Replace
	Loose primary connections	Tighten
	Cracked spark-plug wire	Replace
	Armature air gap too wide	Adjust
	Improper point gap	Adjust
No spark	Dirty or burned points	Clean or replace
	Open or shorted coil	Replace
	Shorted condenser	Replace
	Breaker points open, or failing to open	Correct cause
	Primary wiring shorted	Correct short
Intermittent misfiring at low speed	Point gap too small	Regap
	Weak condenser	Check condenser
	Improper spark-plug gap	Regap
Intermittent misfiring at high speed	Excessive breaker-point gap	Regap
	Weak breaker-point spring	Increase tension or replace
Magneto fails after engine is warm	Internal short in coil due to expansion	Replace coil
	Internal short in condenser due to expansion	Replace condenser
Excessive burning of points	Weak condenser	Replace
	Condenser of wrong capacity	Replace
	Point gap too small	Regap

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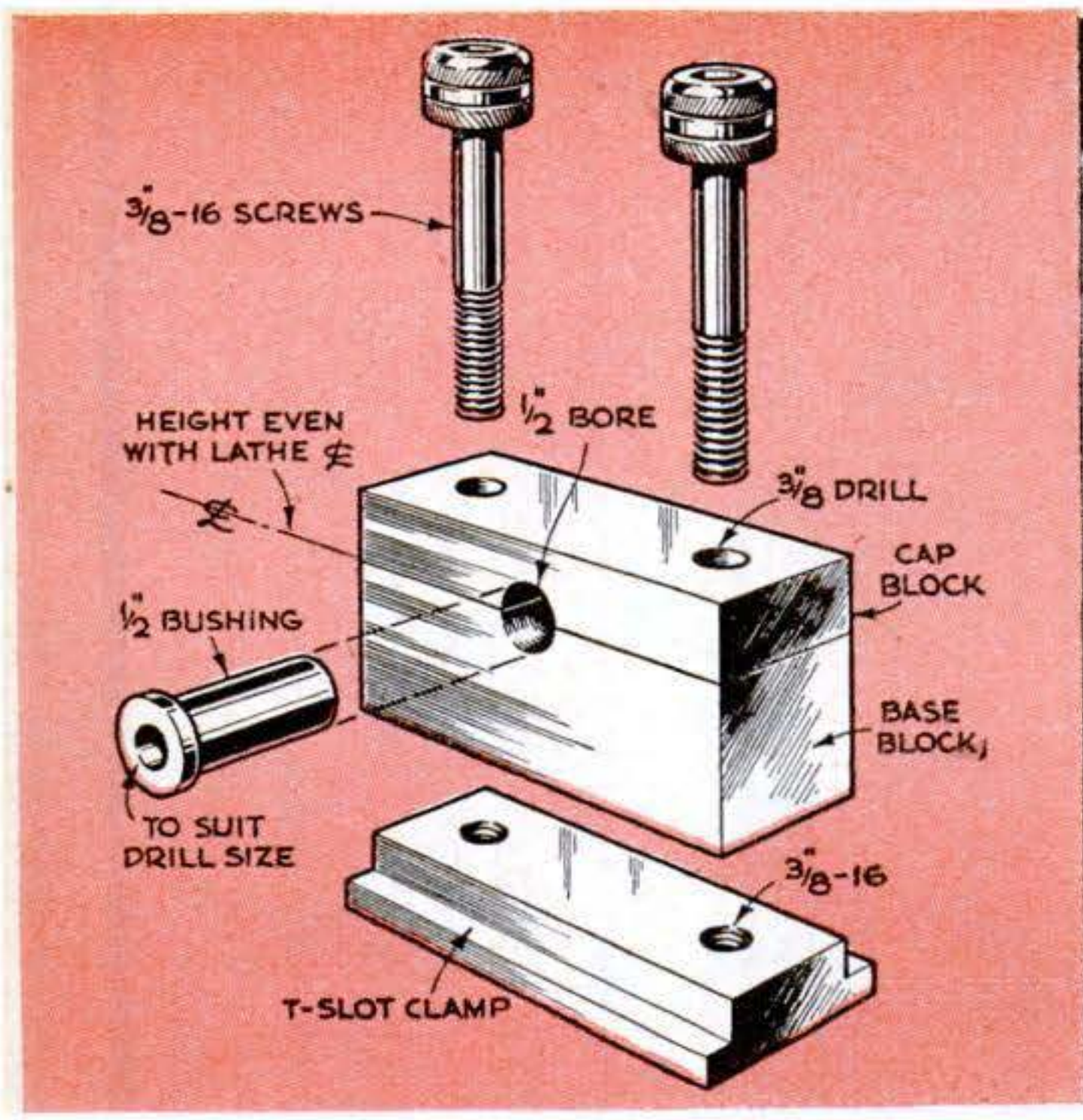
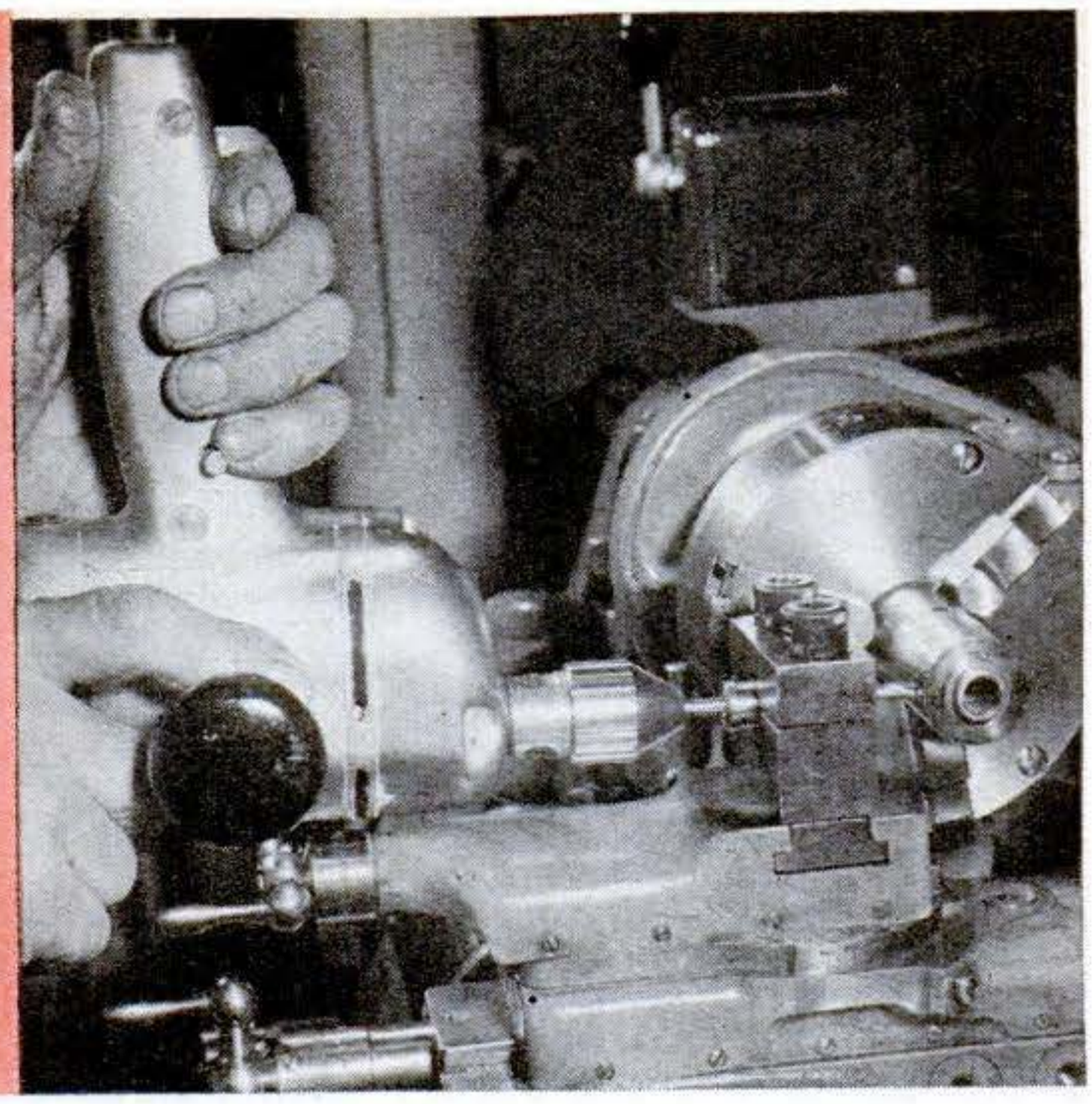


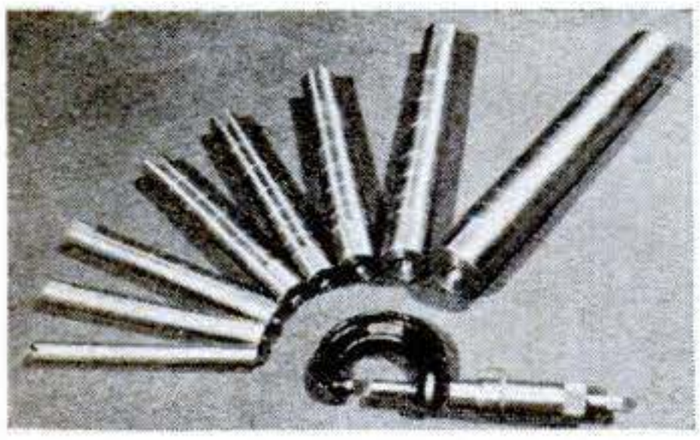


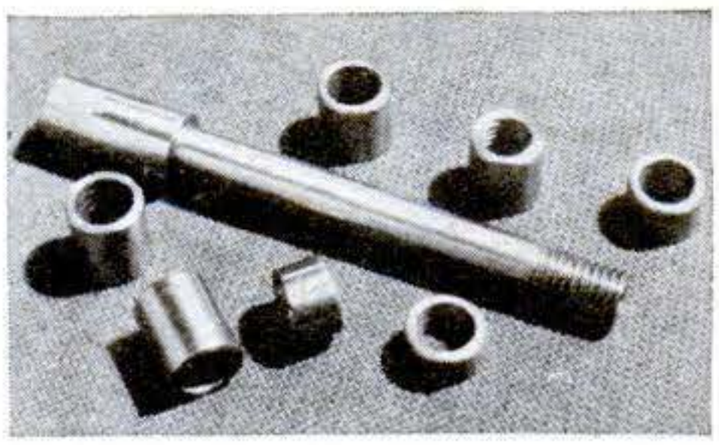
NEW Shop Ideas

Guide Centers Transverse Holes. With this drill jig you can drill holes accurately across the center of work held in the lathe.

The height and direction of the bushing hole are the only critical matters. Fit the three parts together and lock in the compound. Set the compound parallel with the bed and drill a ⅜″ hole with a drill held in the headstock chuck. Bore this hole out to ½″ with a boring bar held between centers.

In use, the compound is turned at right angles to the lathe bed and advanced close up to the work. The drill is then guided into the center of the work by the bushing, one of which must be made for each drill size.—*Joseph Tracy, NYC.*



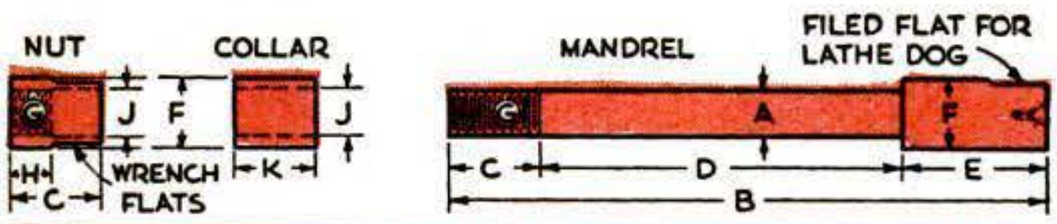


Set of Mandrels Aids Lathe Work. This set of mandrels, ranging from ¼″ to 1″ will solve many of your work-holding problems, such as facing both sides of a flywheel. You can also use them to mount slitting saws and milling cutters between centers for many milling operations in the lathe.

Construction of all the mandrels is the same; only the proportions vary according to the size as shown in the chart at lower left.

Work is held between the collars, which are forced up tight by the end nut. Collars should be a sliding fit over the untapered working area of the mandrel, and are of varying lengths. The mandrel diameters are the only critical dimensions, and should be held to a −.002″tolerance.

Mandrels are turned between centers, and the ends centerdrilled oversize to provide generous bearing surfaces. Flats for the lathe dog are filed on the shank ends of the mandrels. Two wrench flats for tightening are filed on the nuts.—*Will Thomas, Buffalo, N. Y.*



WORK SECTION DIA. (SIZE)	A	1/4″	5/16″	3/8″	7/16″	1/2″	5/8″	3/4″	1″
OVERALL LENGTH	B	3½″	4⅛″	4½″	4¾″	5⅝″	6⅛″	7″	8″
THREAD, NUT LENGTH	C	½″	⅝″	¾″	¾″	⅞″	⅞″	1″	1¼″
WORK SECTION LENGTH	D	2″	2½″	2¾″	3″	3½″	4″	4½″	5″
SHANK LENGTH	E	1″	1″	1″	1″	1¼″	1¼″	1½″	1¾″
SHANK, NUT, COLLAR, O.D.	F	⅜″	15/32″	17/32″	⅝″	11/16″	13/16″	1″	1¼″
THREADS PER INCH	G	20	18	16	14	13	11	10	8

H–THREAD LENGTH IN NUT—SLIGHTLY LESS THAN ½ C
J–COLLAR AND NUT I.D.—SLIDING FIT ON A
K–LENGTH OF COLLAR—VARIABLE FOR PLACING WORK

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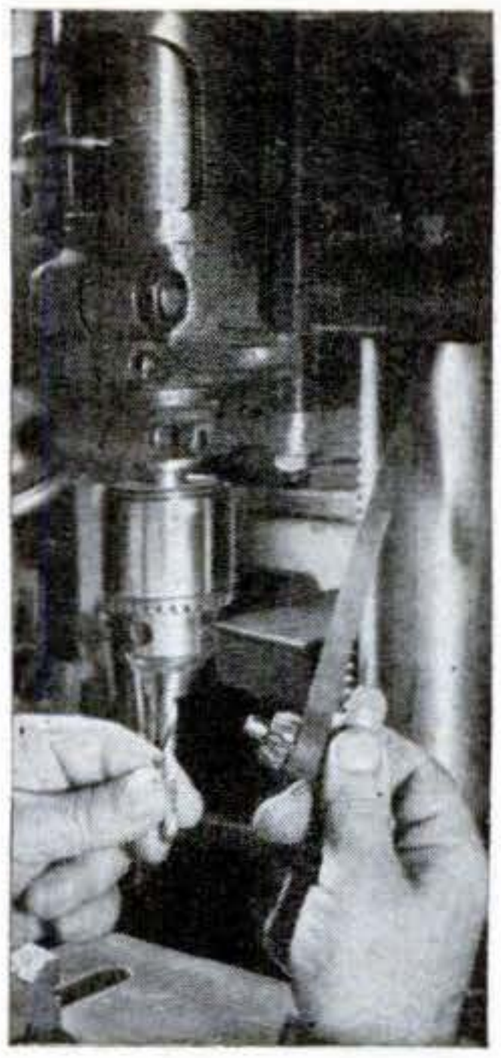
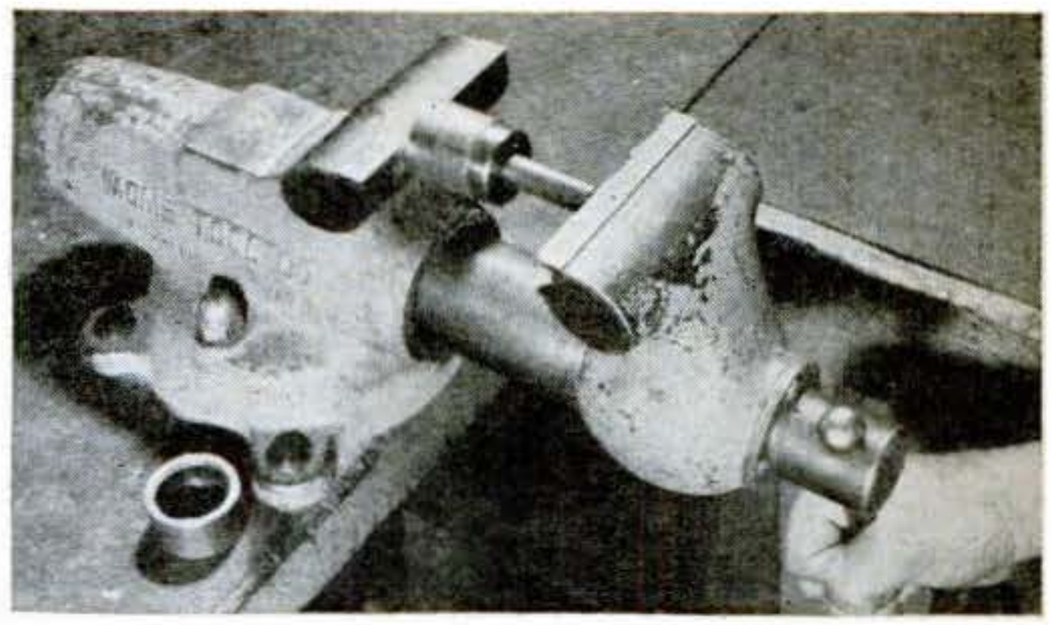
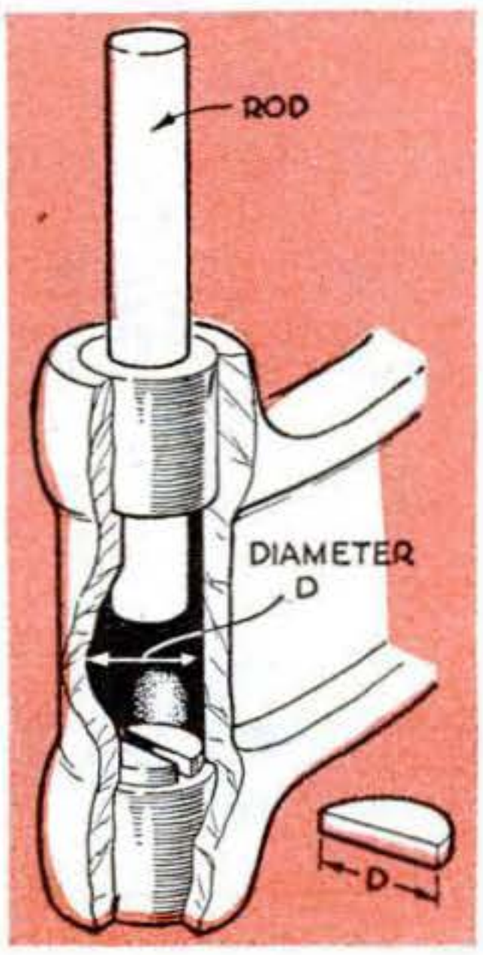


Key Snaps Back. You needn't hunt for the chuck key if it is attached by a rubber strap, nor can you leave it in the chuck, for the rubber snaps it out. Anchor a ½"-wide strip of inner tube to the drill-press head near the column, cutting it so short it must be stretched to reach the chuck. Loop the other end loosely around the key, making the joint with rubber cement.



Make Tubing Telescope. Tubing just a bit too small to telescope with the next size can be expanded as much as .010" by pushing a plug through as above. Turn a slight taper on the plug and turn a recessed anvil (in foreground) to place against the work while the plug is pushed clear through.

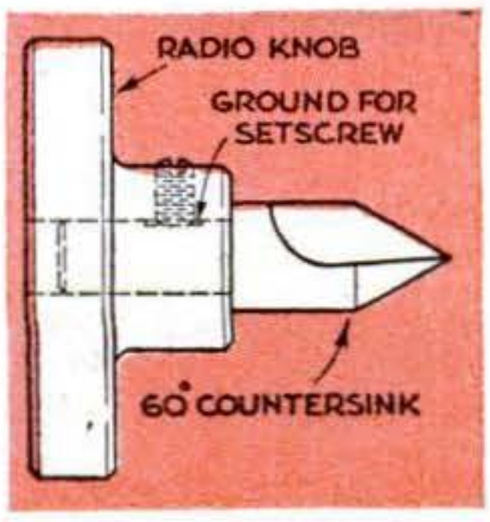
Woodruff Keys Drive Bushings. When rebushing a spindle bore, you can waste time tapping the worn bushing out with a thin rod from the opposite end.



A pair of half-round Woodruff keys, dropped into the bore and shifted to cover the bushing, will permit you to drive it out with a few blows on a rod of about the same diameter as the bushing opening.—*Frank M. Butrick Jr., Alma, Mich.*

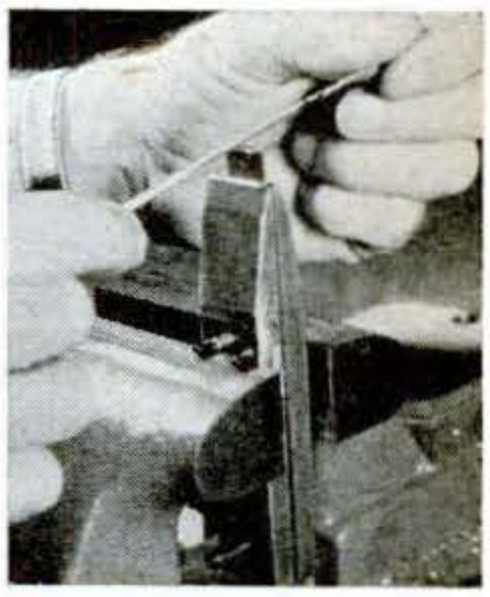
Clay Holds Measuring Wires. When measuring thread diameters with the three-wire method, press the wires into a ball of modeling clay to hold them in position. The clay is soft enough to allow the micrometer to align the wires as it closes on them. —*R. Walker, Bel Air, Md.*

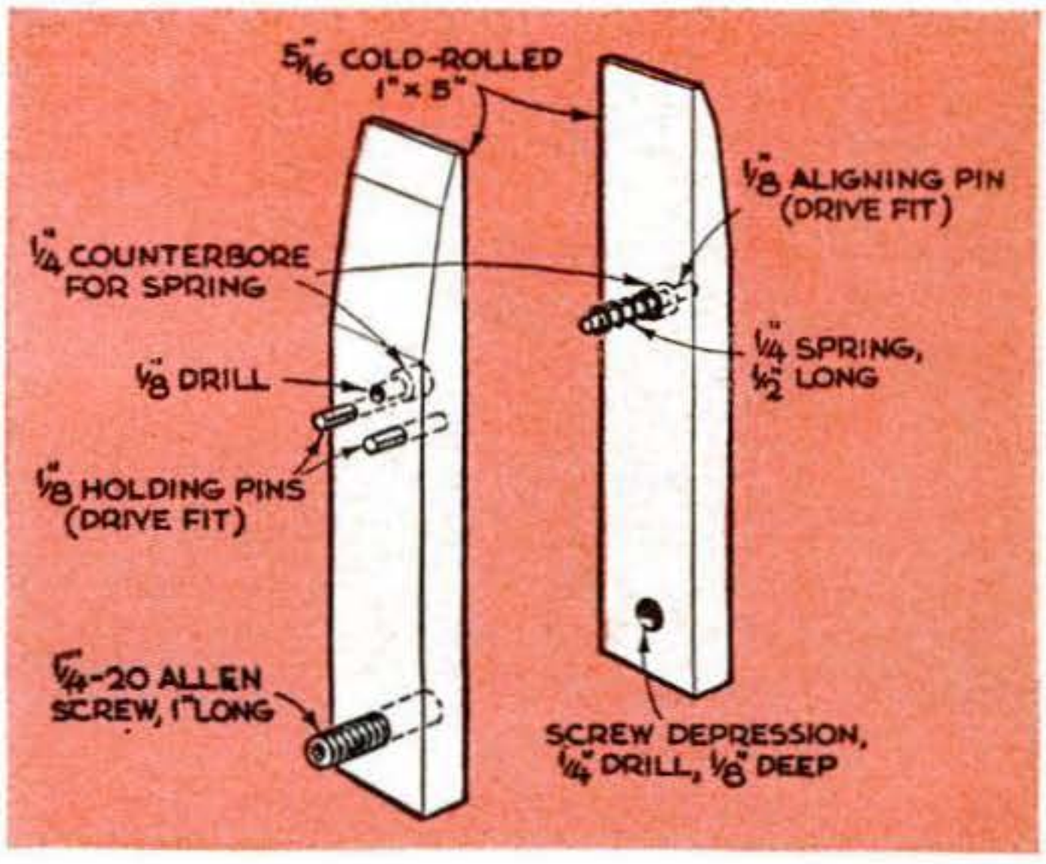
Handy Tool Deburrs Holes. A 60° countersink, set in an old radio knob, will save you time and much drill changing when you must remove the burrs from drilled holes. Grind a flat on the shank of the countersink for the setscrew.—*Roger Isetts, Kenosha, Wis.*



Vise Jaws for Small Work. Use these auxiliary jaws in your bench vise to grip small parts while you perform hand operations on them. You'll find the parts easier to see and less likely to be crushed.

Two scraps of flat stock and some ⅛" drill rod from your scrap box are all you need to make the jaws. To use, drop the jaws between the vise jaws—the holding pins will support them—and adjust the Allen screw to separate the bottom slightly more than the thickness of the piece to be held. Place the work between the jaws and tighten the vise enough to secure it. The spring, which is housed in the two ¼" counterbores when compressed, opens the jaws when the vise pressure is released.—*Henry Sevcik, Los Angeles, Calif.*





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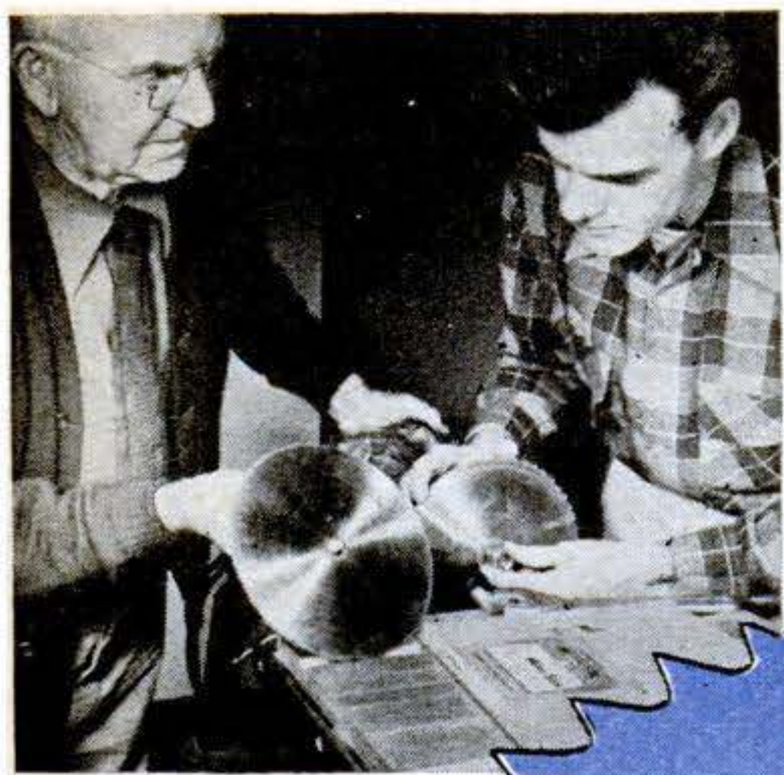
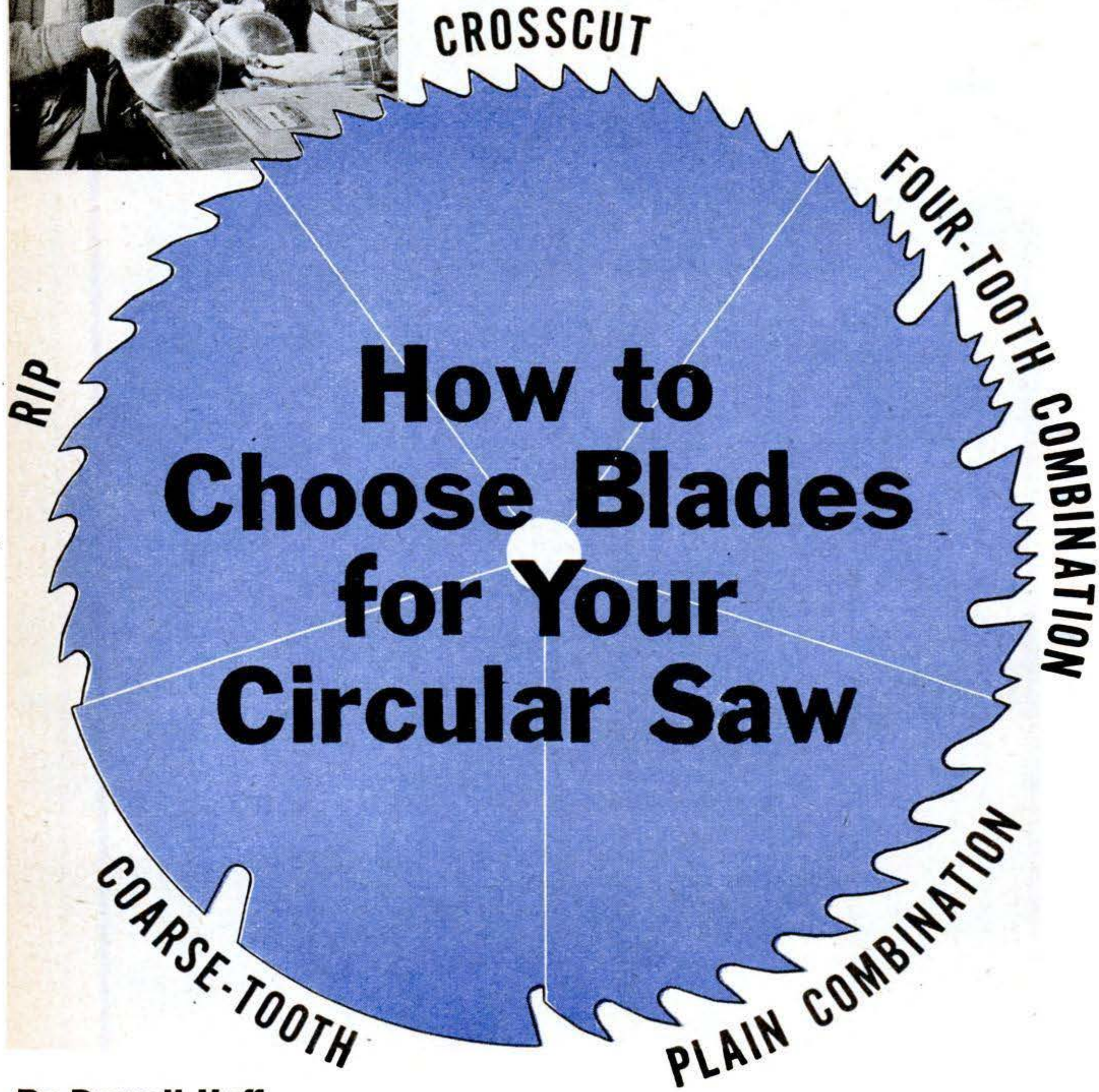


You can buy a lot of blades and still not have the one you need. Knowing what types there are and when to use them will save your money—and your blades.



How to Choose Blades for Your Circular Saw

By Darrell Huff

"DOGGONE, stalled again!" grumbled my neighbor, Mike Oaks. "Haven't had this table saw six months and now the blade binds and the motor jams."

"Turn it off and let's have a look," suggested Joe Nix, another neighbor of mine. He cleaned his bifocals and put them on.

I kept quiet. When Joe Nix talks, I listen. He used to be a saw maker, and he knows power tools about as well as anyone you'd hope to meet.

Joe squinted at the blade. "Dull," he said. "Get it sharpened and it'll cut."

"But that's a hollow-ground blade," exclaimed Mike. "I figured with what I paid for it, it should last . . ."

Joe held up his hand. "What you paid for was the hollow grind—the business of grinding the blade down so it is thicker at the teeth and center than in between. That way, the blade runs freely in the cut without the teeth needing any set."

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"Set is where the teeth are alternately bent left and right?" asked Mike.

Joe nodded. "The set in a flat-ground blade produces a wide kerf so the blade won't bind. But it gives a rougher cut. Now a hollow-ground blade gives you a very smooth cut and saves a lot of work, but it costs about three times as much."

"How many kinds of blades are there?"

"About a dozen that are useful in the home workshop."

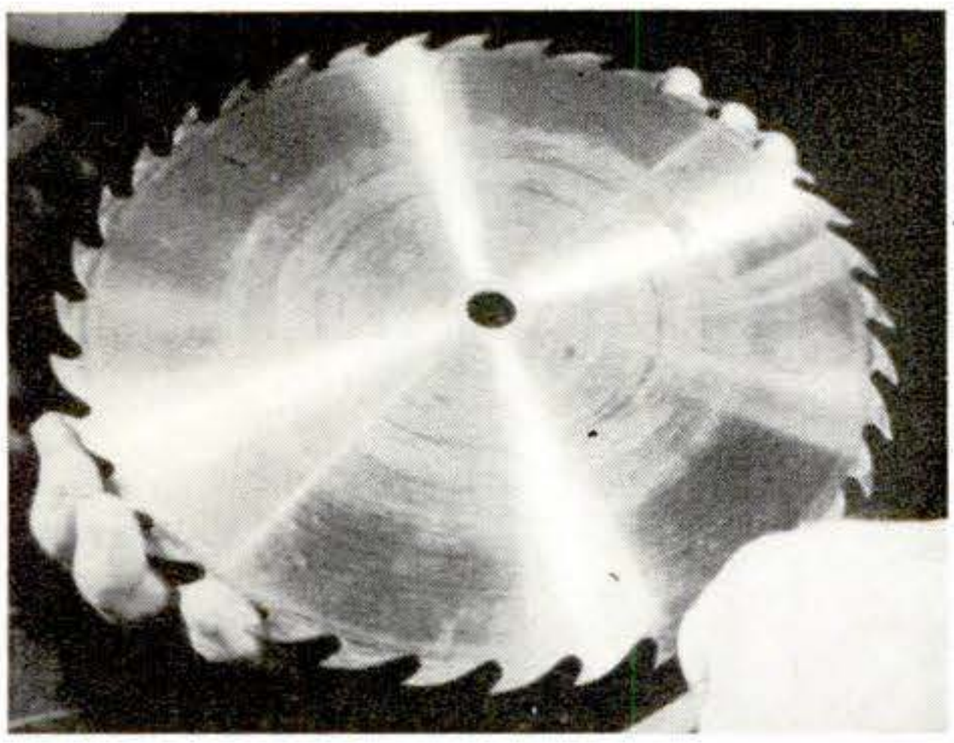
"Yike," yelped Mike, "that's expensive."

Joe grinned. "Maybe I'm prejudiced because I used to be in the business, but I can't see that it costs any more to stock the blades you need than to try to sneak by with one or two and then spend your money having them resharpened all the time.

"Look," Joe added, "I'll slip over to the house and fetch some of my blades to give you an idea what I mean."

It was quite a collection that he brought back.

"There are, of course, three types of blades for your circular saw," Joe began. "Rip, crosscut, and combination. This one's a standard ripsaw, flat-ground.



"When you cut with the grain of the wood, you need teeth like these. They act like tiny chisels to rout out the wood. The gullets—these curved places between the teeth—scoop out the sawdust. Here, try it."

Mike took the blade Joe handed him and started to put it on the saw.

"Say," frowned Joe, "is that how you always put on a blade—just any old way?"

Mike looked puzzled. "Sure, why?"

"A blade should be mounted with the trademark at the top and lined up with the scribe mark on the arbor. Then you're sure it's always on the same way."

"But the blade's round. What difference does it make how it's put on?"

Joe chuckled. "That's just it—the blade's not round. You see, the hole must be a little larger than the arbor so you can get the blade on. That means the radius of the top is slightly shorter than that of the bottom half that hangs down. When the blade's sharpened, the bottom teeth are ground down shorter than the top ones so both radiuses will be the same. But if you got the blade on wrong with the short teeth at the top, it would be out-of-round. That's why you always want to put it on the same way—the way it was ground."

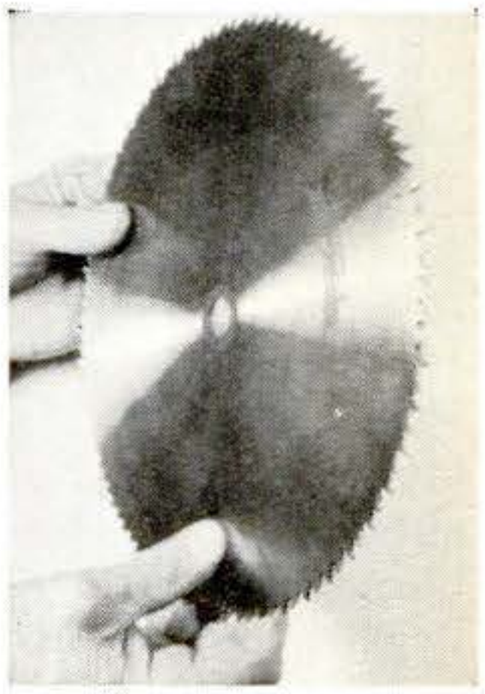
Crosscut Teeth Shear Wood

Mike carefully lined up the blade, turned on the motor and ran his half-ripped two-by-four the rest of the way through. It went fast and cleanly.

"Well, that's better," smiled Mike. Then he looked critically at the piece of fir. "But it's not such a smooth cut."

"No," agreed Joe. "You use a rip blade for rough work and when you want to do a lot of ripping quickly."

Joe spread out three more blades. "Now let's take a look at the blades used for crosscutting, generally called cutoff blades. These must shear the grain of the wood, so the teeth have an alternate face bevel, providing sharp knife edges to the left and right. This one's a regular flat-ground cutoff."



"That's the one to use if I have a lot of crosscutting to do?" put in Mike.

"Right—unless you need very smooth cuts. Then you'd like this smooth trimmer. It's a hollow-ground cutoff saw. The teeth have a 45° bevel so they act like knives and actually plane the ends of the lumber."

Mike pointed to the third cutoff saw. "This one has teeth so tiny they look like milling on a dime. What's it good for?"

"That's called a miter blade. You'd use it for extremely smooth cutting off and mitering on light stock. It's especially good for anyone doing fine work—models, small boxes and suchlike."

"Say, what about blades for a portable saw?" asked Mike. "My wife is after me to build a sun porch, and I'm going to get a portable if I do that job."

"It'll use the same types as the table

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or radial-arm saw," Joe told him. "Except that the blades will have special center holes to fit your particular brand of saw. There are also a couple of kinds made just for portables. One is a fine-tooth cutoff for quick sawing of soft wallboards and insulation boards. Another is a flooring cutoff, sometimes called a nail saw. It's good for old flooring, secondhand lumber, anything where you might hit a nail."

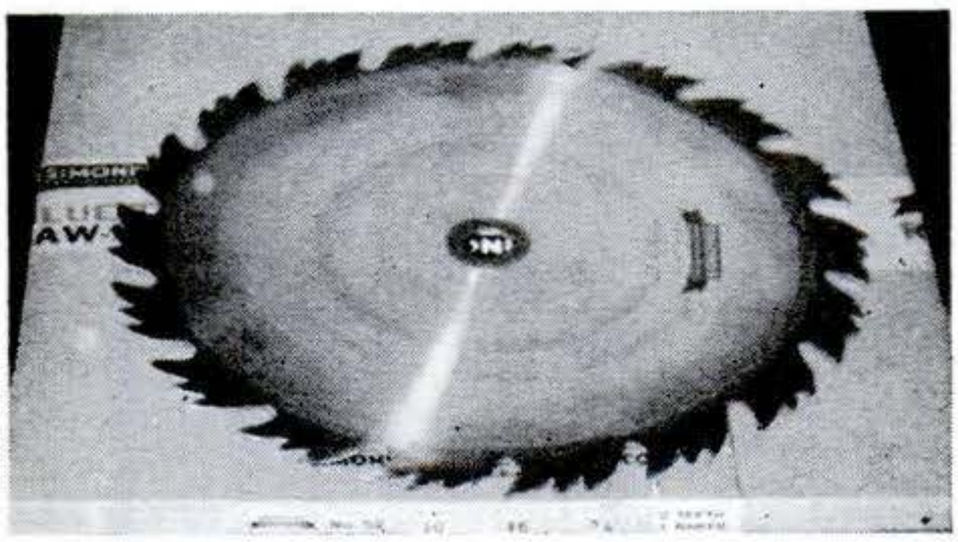
Joe brought out some more blades. "The rest of these are combinations. Any of them will do ripping, crosscutting or mitering. You use them to avoid changing blades every other minute."

Mike and I examined the first one. I could hardly tell it from the rip blade until I saw that the teeth had a little less hook and were beveled.

Joe was smiling. "This is the plain-tooth, flat-ground combination, a good all-around blade for moderately rough cutting. It cuts fast and is easy to sharpen because all the teeth are alike."

Mike was eyeing an odd-looking blade with an unusual arrangement of teeth. "What's this one?"

"That's another flat-ground combination.



Each section has two cutting teeth and a raker, so it's often called a novelty saw. It cuts smoother than the ordinary combination, but takes a little more power."

Mike picked up the next blade. "Let me try to guess this one. It's the same as the last, but has four teeth to each raker. It probably cuts smoother still."

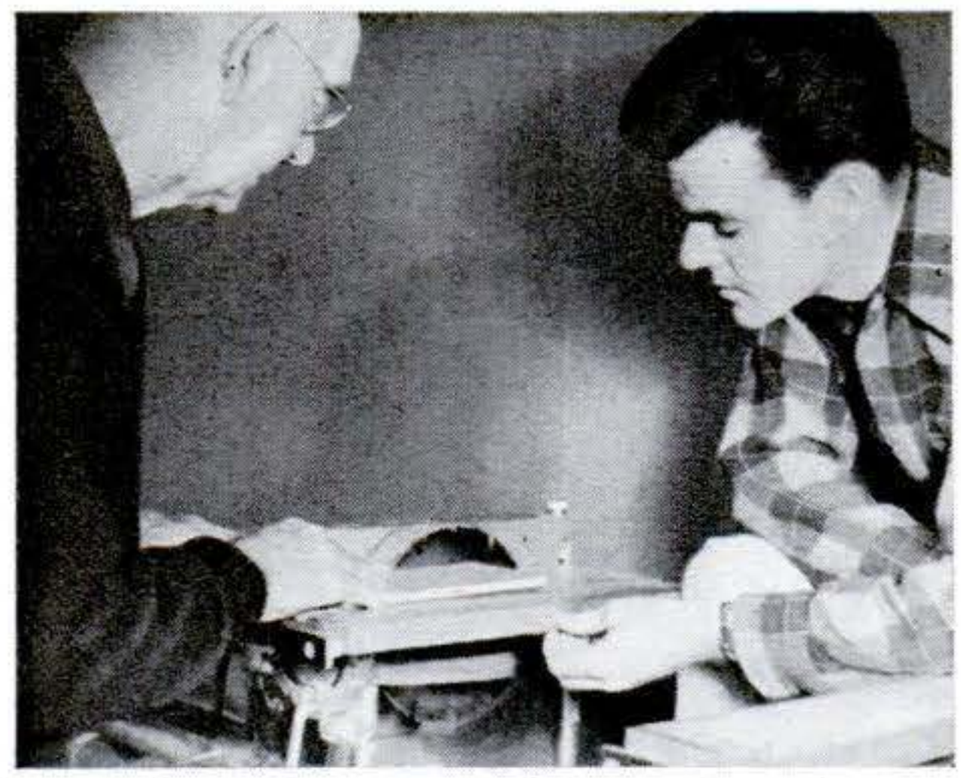
"Good guessing." Then a twinkle came into Joe's eyes. "Since you did so well on the last one, how about this blade?"

Mike studied it closely. "It has four teeth to each raker like the last one, but this one's hollow-ground."

Suddenly Mike looked at Joe and grinned sheepishly. "In other words," he concluded, "it's a planer blade just like the one I was using when you came in!"

"Right. It gives smooth cuts in any direction—rip, crosscut or miter. It saves a lot of planing and sanding, too, but you do have to keep it sharp.

"That reminds me of another thing," Joe added, as he started to raise Mike's saw. "Any hollow-ground blade will cut better and last longer if you give it plenty of depth like this. The blade should project through



the work as far as possible so that the teeth run free. Prevents burning."

Mike looked around for more blades. "Is that the last of them?"

"It would have been up until a few years ago. But there's one important development since then. This coarse-tooth number first showed up as an import and is now being widely used. It is sometimes called an easy-cut or cut control or safety blade."

Mike looked surprised. "Why, it has only —let's see—eight teeth. It actually cuts wood?"

"Try it and see."

Mike ripped a scrap of tough two-by-four easily. Then he tried it for cutoff and a miter. It did the last two easily, too, but gave a rather rough cut.

"Nice thing about this type of blade is that it takes less power than types with more teeth. Since most home-shop saws are powered by fairly light-duty ⅓- or ½-horse motors, that's a real advantage when you're cutting tough or thick stock."

Carbide Teeth Last Longest

"You called it a safety blade," Mike pointed out. "That mean you can't hurt yourself with it?"

"I'm afraid that's asking too much, but it does have less kickback than ordinary blades, and it's supposed to push your hand away instead of pull it in."

Joe reached into his box of blades. "Here's a fancy version of the same blade —the teeth have carbide tips. It makes a wider kerf, so it calls for a little more pow-

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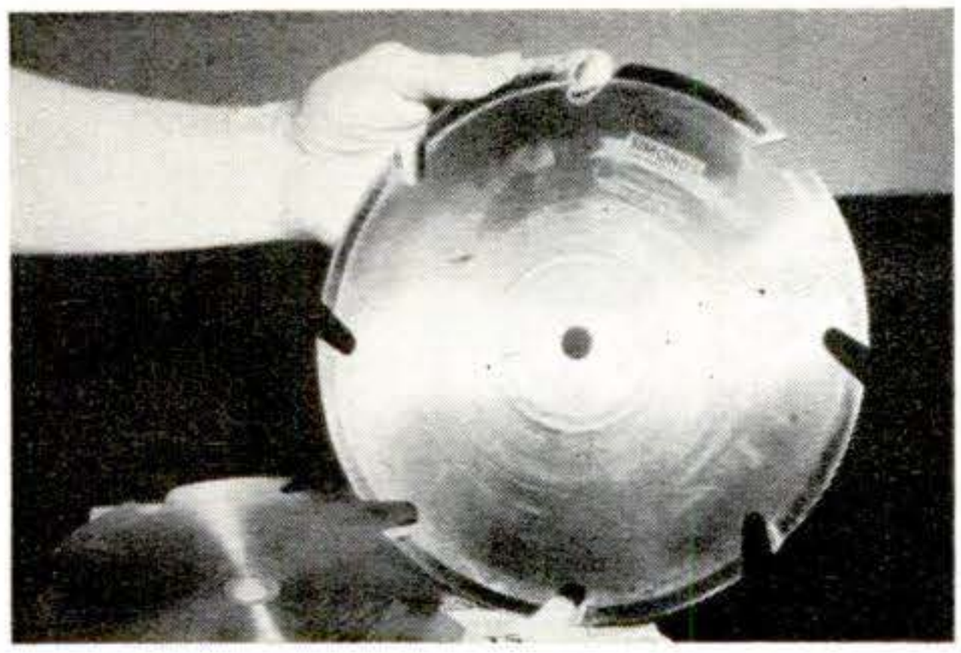


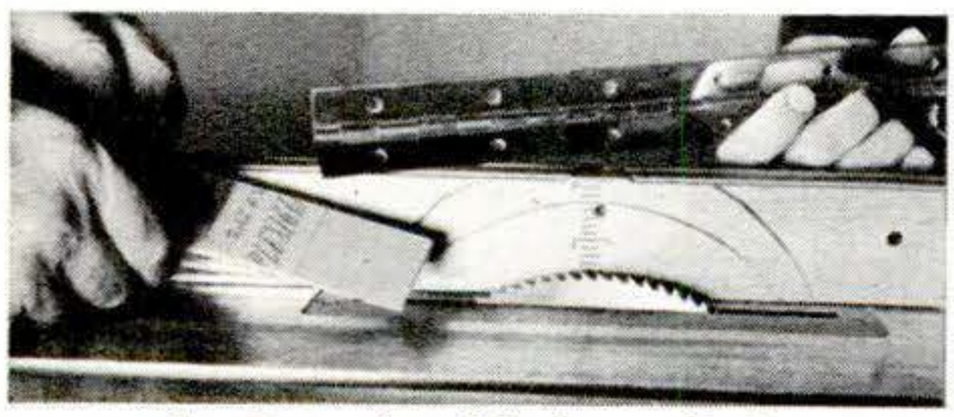
er, but it'll do just as good a job on ripping and a lot smoother one on crosscutting. And the tips stay sharp almost forever."

"There's one other problem I have," said Mike. "Can I get a blade that'll saw metals and plastics?"

Joe checked through his blade box, "There's one blade—yes, here it is—that does most of those jobs very well. It's called a nonferrous-metal-cutting blade."

"Not for iron or steel, eh?"

"No, for those you'd better use a flexible abrasive wheel if your hacksaw arm

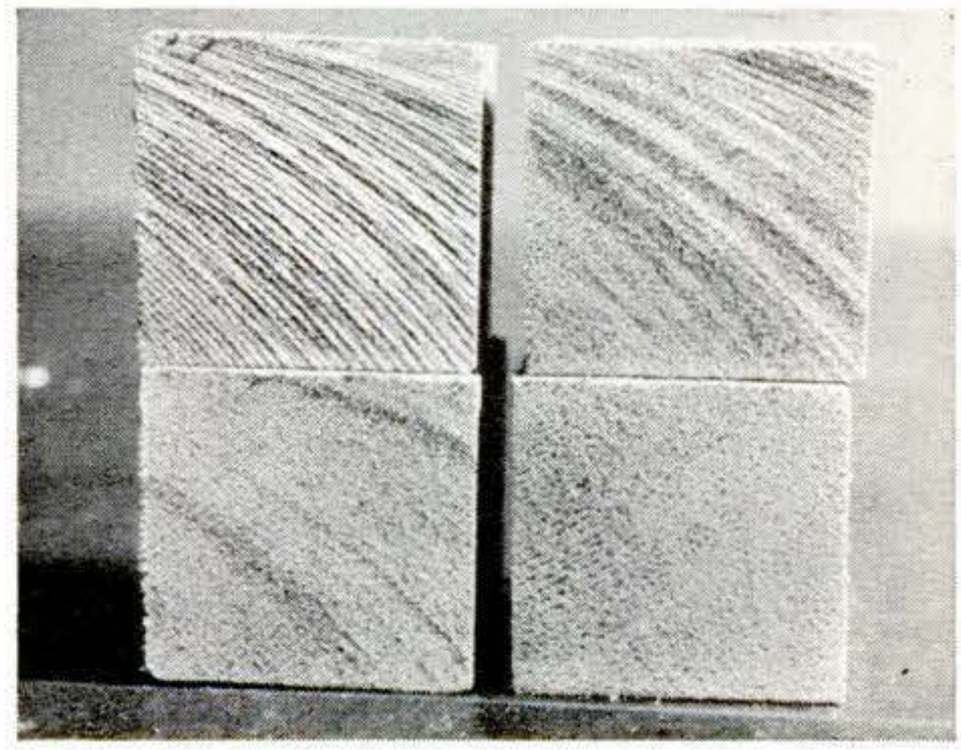


gets tired. But this blade will do a good job on aluminum, brass, bronze and magnesium as well as most plastics. You can get it either flat- or hollow-ground."

"So all I need around here is a dozen blades," sighed Mike.

"So all you need is what your work calls for," countered Joe. "You've got a good start with that planer blade for furniture and other demanding work. Get a combination, either the regular or eight-tooth kind, for rougher work so you won't dull the hollow-ground. Then you can add other blades as you need them."

As he talked, Joe piled up a stack of four scraps on the bench. "You can get an idea from these exactly what kind of cut each blade makes. The top one here on the left is the coarsest cut, made by the regu-



lar cutoff saw. One on the right is the flat-ground combination. Still smoother is the eight-tooth carbide blade on the bottom there at the left. And guess what made the one on the right, the smoothest cut of all? That's your planer blade you were having so much trouble with." END

CIRCULAR-SAW BLADES

Use first choice if you have it, second or third if you don't—or to save changing blades.

The Job	*First Choice*	*Second Choice*	*Third Choice*
Heavy crosscutting, such as studs and timbers for building	**8-tooth, carbide-tipped**	**cutoff**	**flat-ground combination**
Heavy ripping	**8-tooth**	**rip**	**combination**
Light ripping	**8-tooth, carbide-tipped**	**8-tooth or rip**	**combination or planer**
General woodworking and furniture	**planer**	**flat-ground combination**	**8-tooth, carbide-tipped**
Fine cutoff and mitering thin stock	**smooth trimmer or miter blade**	**planer**	**combination**
Plywood and hardboard	**8-tooth, carbide-tipped**	**combination**	**planer (will dull fast)**
Plastics, soft metals	**nonferrous-metal-cutting**		

FOR YOUR *POPULAR SCIENCE MONTHLY* INFORMATION FILE

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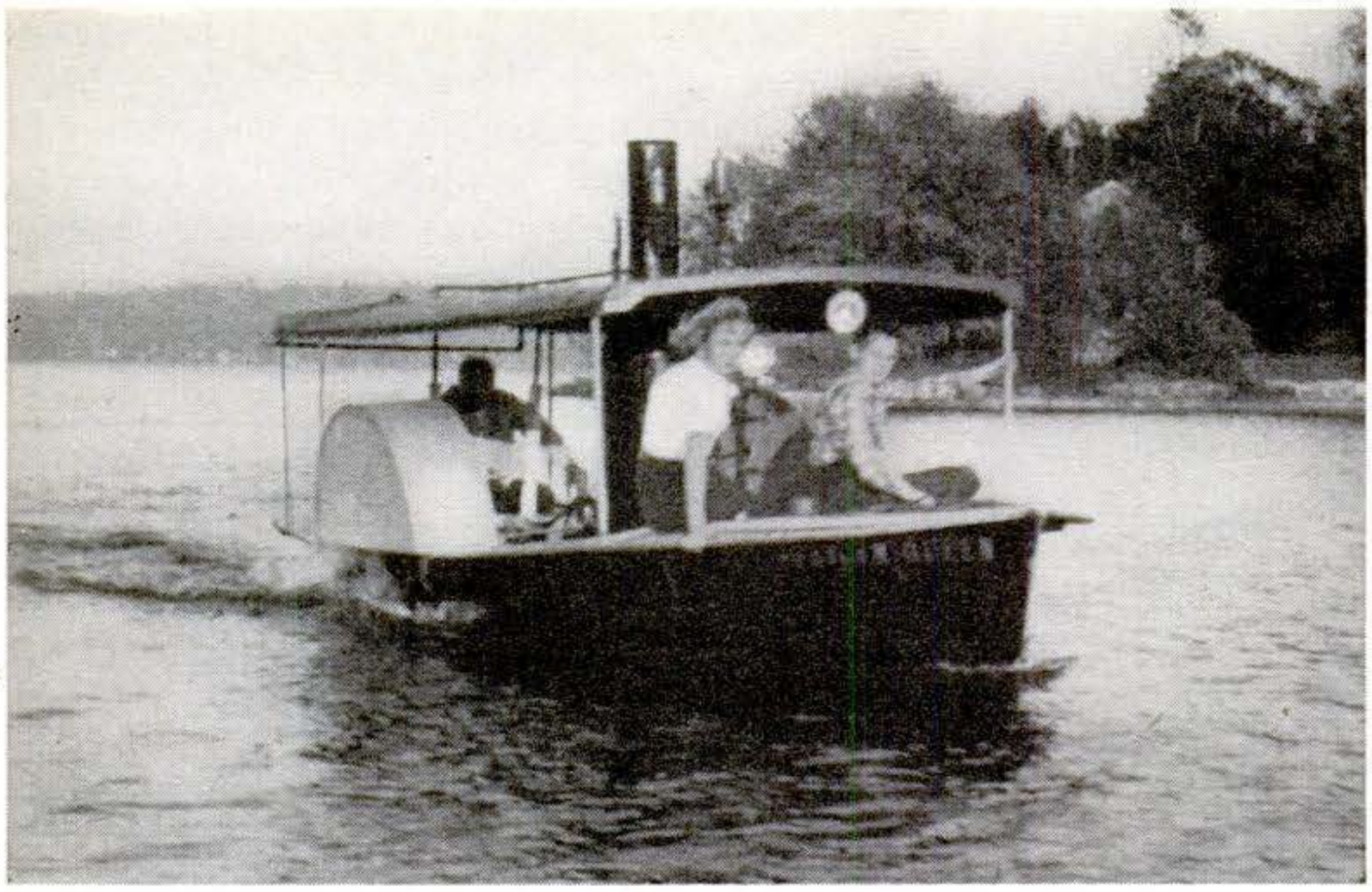


Connecticut's own *African Queen* has paddle wheels instead of a prop and would delight any steam fan. Its builder fires it on scrap lumber, apple crates, and broken chairs. The hull is an old 18′ fishing boat of 5′ beam, with ballast added to counteract effect of tall boiler. At 180 r.p.m., engine turns the paddle wheels 40 times a minute and the little side-wheeler does a few modest knots. Reverse, rudder and throttle give excellent control and maneuverability.

Steam-Car Engine Runs Side-Wheeler

Ever wished you had a steamboat? Look what one fan did with an old hull, a Locomobile engine, a homemade boiler and a couple of wagon wheels.

GAS engines are fine if you just want to get some place, says Richard T. Finn, of Litchfield, Conn. But for years he dreamed of a real steamboat, with an engine he could see go round, and oil up and tinker with. It took a long series of finds and swaps to turn up the necessary parts.

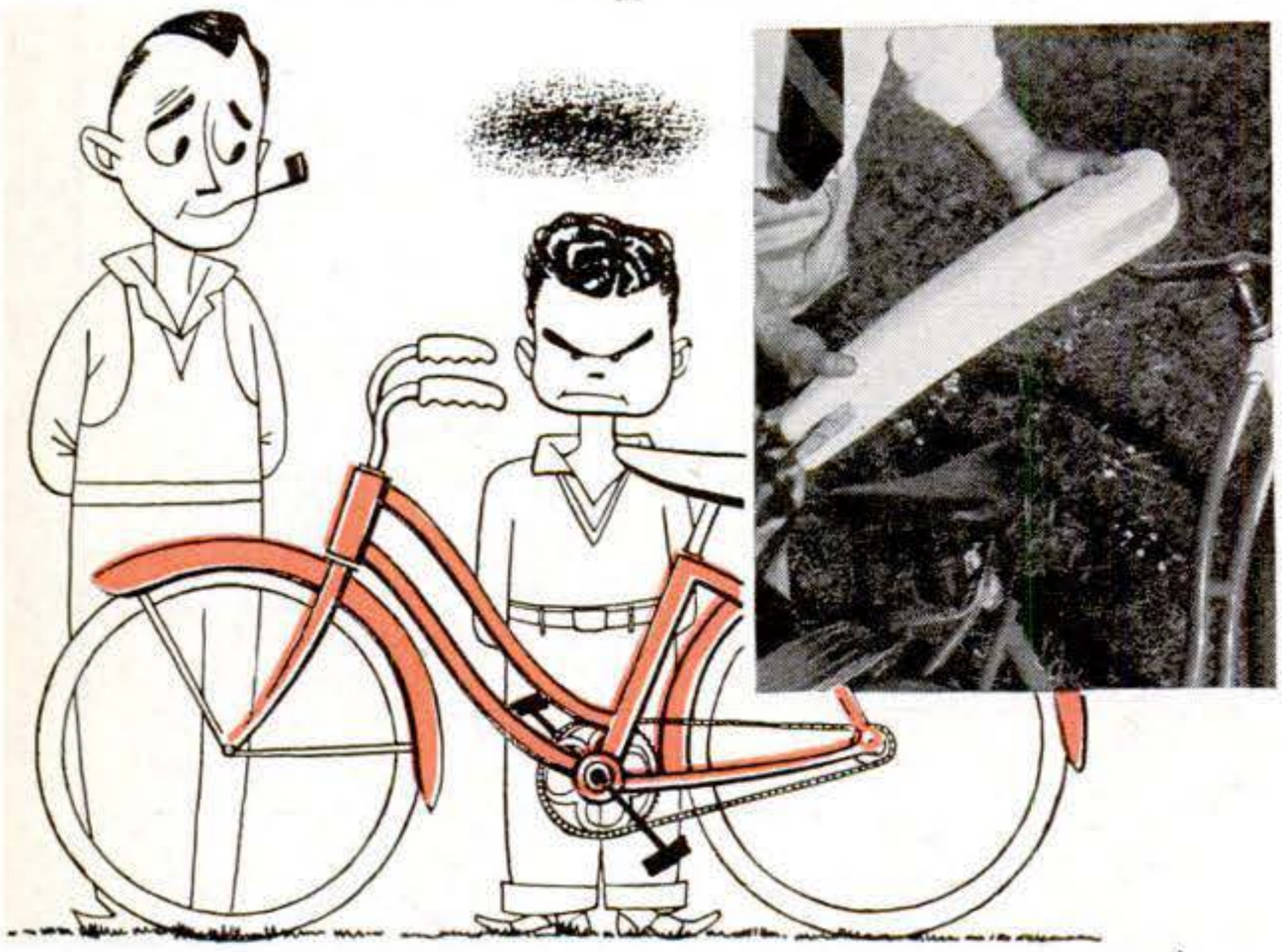
Now he has an *African Queen* on which, with a few armfuls of wood, you can sail all day to the pleasant chuffing of a steam engine and the soft slap of paddle wheels.

The two-cylinder engine, of 2½″ bore by 4″ stroke, is from a Locomobile steam car. Having no dead center (the cranks are 90° apart) it can be started, stopped, or reversed from any position, like a locomotive, by a lever that controls the valve motion. A throttle controls speed.

The engine shaft had an old-fashioned block-chain sprocket that could not be removed without dismantling the engine. Finn eventually found some block chain, and a large matching sprocket. With this on the wheel shaft, he had a 1 to 4½ reduction.

Paddle wheels were made by bolting 8″ by 9″ pieces of marine plywood to every

Is Your Boy About to Inherit Big Sister's Bike?



WHEN my oldest girl was presented with a new 28″ bike, her younger brother was in line to take over her 26″ wheel. But it wasn't long before his playmates made him realize that boys don't ride girls' bikes—and we had a problem.

The bicycle repair shop offered to solve it by welding an extra bar into the frame, and wanted all but a corner of a $10 bill for the job. Instead, a homemade dummy tank did the trick at practically no cost. It added a slick custom-built touch

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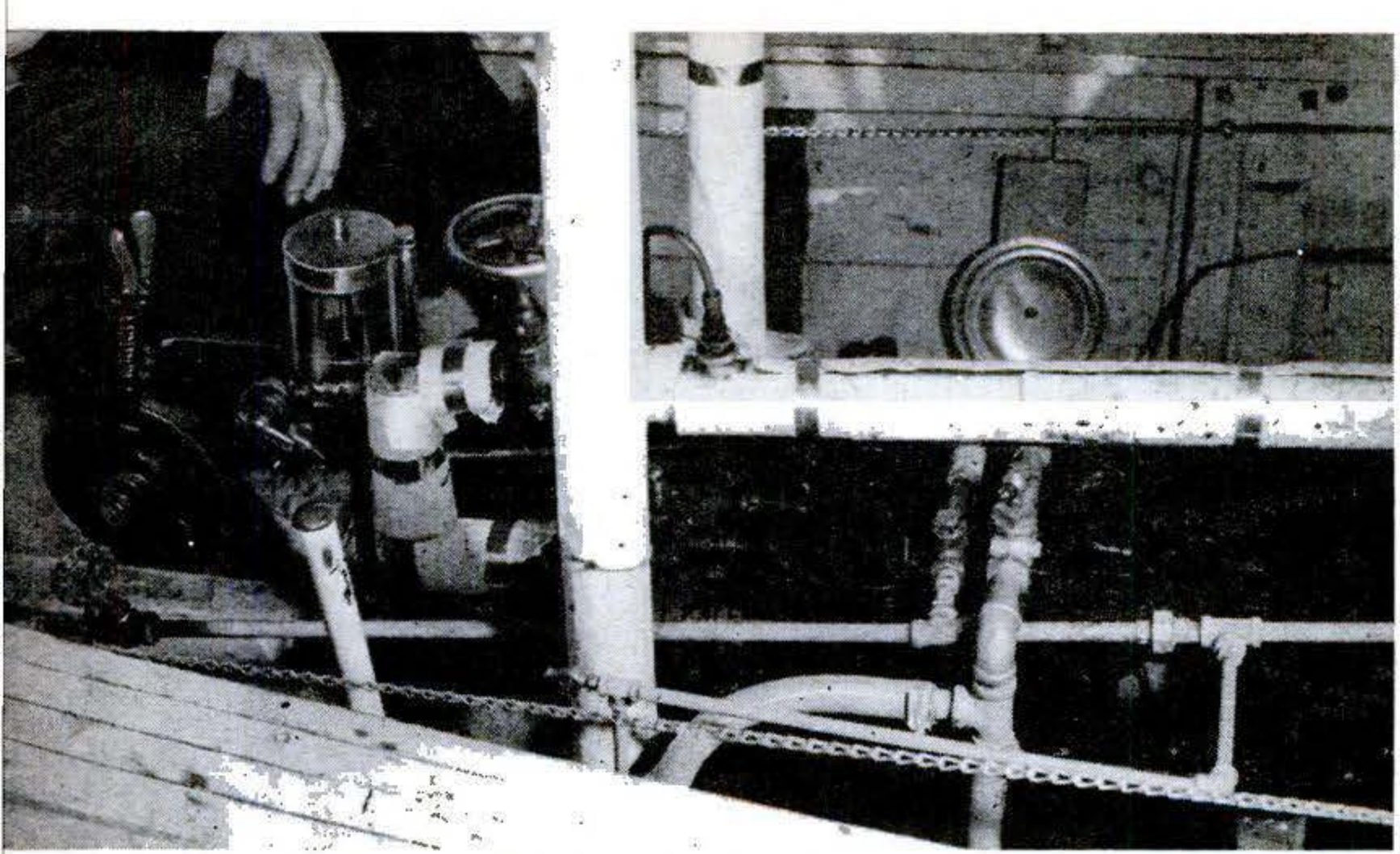
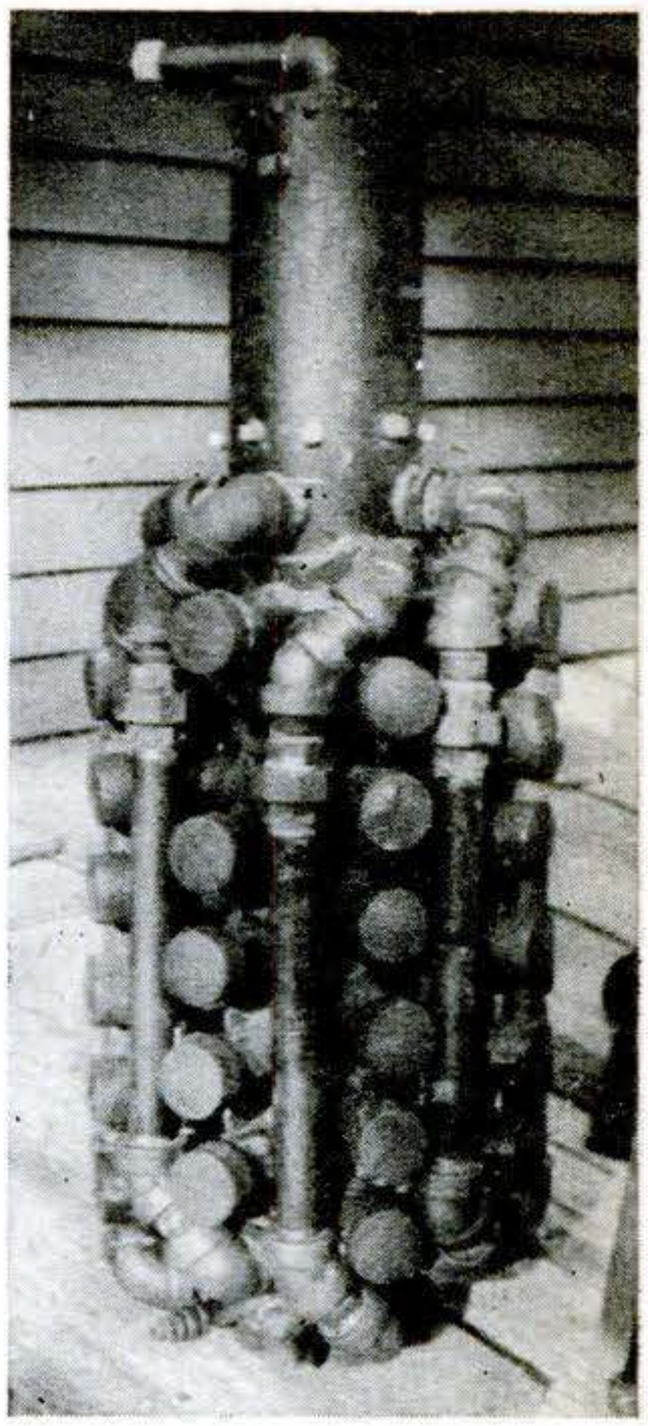


Engine is reversible by valve link motion controlled by lever at far left. Lubrication is provided by engine-driven pump that forces oil into steam line. Throttle wheel (behind pipe) is old sewing-machine flywheel.



Porcupine boiler is a piece of 4" heavy-duty pipe with capped nipples added to increase heating surface. Vertical pipes improve up-and-down water circulation and steaming.

other spoke of a pair of small wagon wheels. They are not damaged if the boat runs aground, and Finn blithely sails into shallow or weedy water that would foul a prop.

The paddle-wheel shaft turns in oil-soaked oak bearings bolted to the gunwales. A center bearing keeps it from bending under the pull of the drive chain.

Finn's boiler was made by screwing a lot of capped pipe nipples into a length of 4" pipe. Its outer casing was once a household boiler. It has ample draft for wood, but Finn added a pipe and valve to shoot the engine exhaust up the stack, creating enough draft to burn coal if he likes.

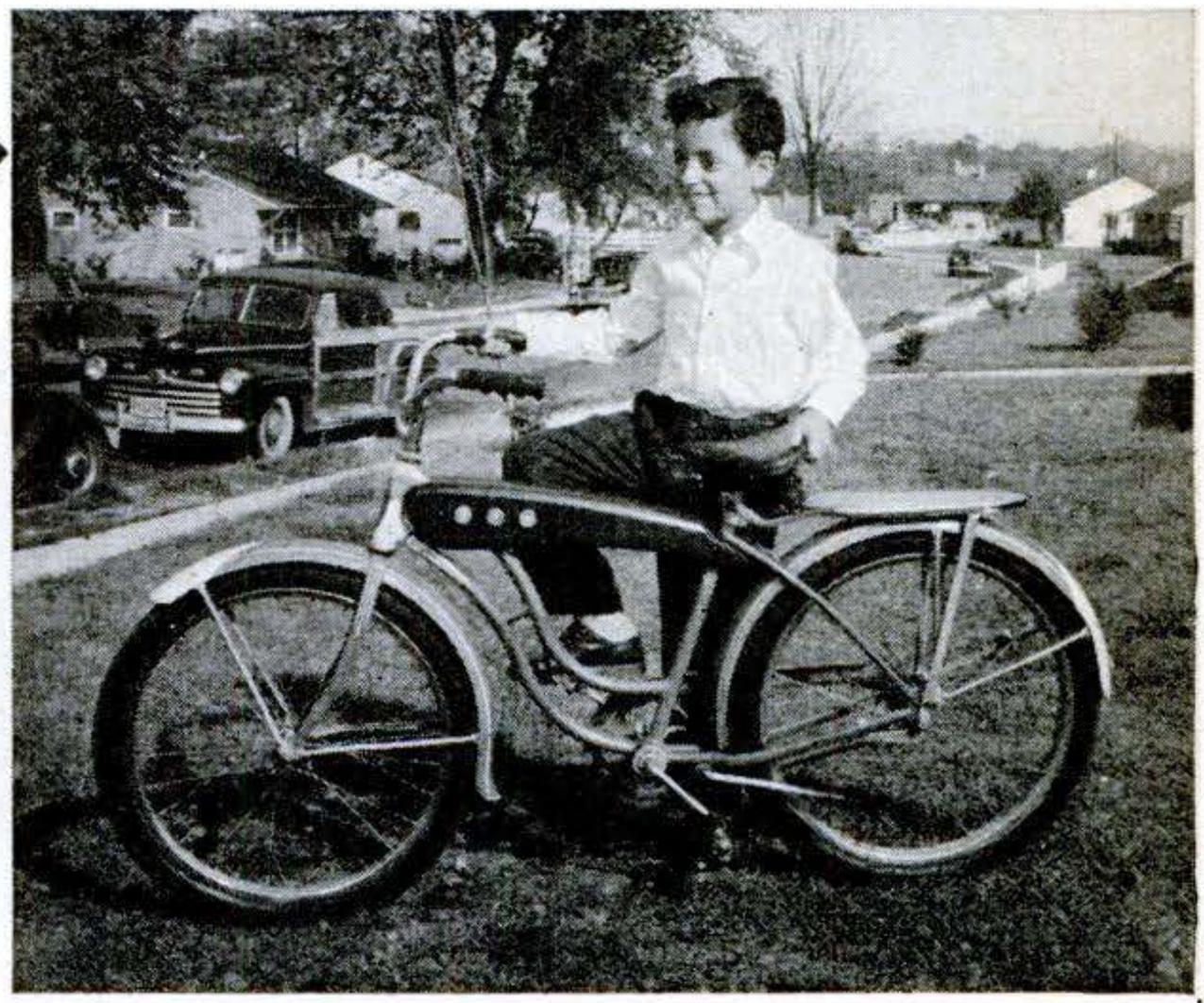
Tested to 250 p.s.i. cold-water pressure, the boiler has a safety valve that blows at 40 lb. The boat runs nicely with 30 lb. and will move on as little as 10. Water is pumped into the boiler by hand when the engine is not running, and by a power pump driven from a crosshead when under way.

To scurry from throttle to fire door over the *Queen's* machinery takes acrobatic enthusiasm. Although Finn has sailed alone, a fireman helper makes it more fun. END

...Here's a Way Out

to the bike and satisfied brother.

It was built as a sandwich, the centerpiece cut to fit snugly between the upper frame members and planed to a thickness equal to that of the frame tubing. The two outer pieces were shaped to blend with the bike's lines and glued to each side of the centerpiece. Two carriage bolts clamped the tank securely in the frame. A coat of paint and six reflectors completed the job.—*Herbert Pfister, Glen Cove, L.I.*



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[Continued from page 131]

works in reverse. His little black boxes receive radar signals from outside sources and break them down. By electronic analysis of the frequencies he can tell what type of radar they come from (friend or foe).

Activity at the CIC officer's console interrupts us. Commander Rowe tells me to plug in my earphones.

"Seven Baysides at Angels Four"

I hear the crisp voice of the CIC officer making contact with the *Coral Sea*, command ship of the task force, "Hello, Birch Tree. This is Seven Baysides 100 miles northwest of you at Angels four (4,000 feet) proceeding to station. What are my instructions?"

"Hello, Seven Baysides. This is Birch Tree. Your instructions are to take station 60 miles west of us and conduct barrier patrol normal to course of Peter Item Mike (Point of Intended Movement). Your area of responsibility is 210 degrees to 300 degrees."

That means we will be flying a back-and-forth barrier patrol of 70 miles. We drop down a couple of thousand feet and slow to an economical cruising speed. We are going to be on this job about 13 hours.

Radar controllers one, two and three are assigned the task of air search for enemy planes. Each one concentrates on a different section of the scope picture. Controller four is put on weather reconnaissance and station keeping (informing the pilot when we reach the terminals of our patrol run).

Jet Interceptor Launched

Birch Tree informs us that our CAP (Combat Air Patrol), a jet night interceptor, has been launched and that we should establish radio contact with him. His code name is Anyface One.

"Anyface One, this is Seven Baysides. What is your position?"

"Seven Baysides, this is Anyface One. Twenty miles west of Birch Tree at Angels 15."

"Roger, Anyface One. Vector 270 degrees for identification."

As the arm sweeps around the scope we see a pip turning due west. We have established the identity of Anyface One.

It's a little after three o'clock in the morning. An early breakfast of scrambled eggs, baked beans, coffee and milk is served. Commander Rowe relieves the CIC officer, and as there is no unusual activity on the scope I take the opportunity to learn some more about this complex business of radar patrol.

Radar Picture Televised to Carrier

Projecting from a movable arm above the radar console is a little triangular black box. It's a tiny TV camera for video insertion on the scopes of the controllers of anything the CIC officer writes or draws on his scope glass. But there's more TV than that. Next to the cargo door is a large unit called a video relay that enables the AEW plane to televise its radarscope picture to the CIC aboard the aircraft carrier. It also can pick up a scope picture from a more distant AEW plane and retransmit it to the carrier.

The voice of Controller Two comes over the radio: "Bogey (unidentified plane) closing 250 degrees at 120 miles. Speed 200."

Height-Finder Radar Comes into Play

Commander Rowe directs Controller Four to establish altitude of the Bogey. (It's a P2-V Neptune from Jacksonville Naval Air Station.) This brings into play the airborne height-finder radar, used for the first time in this exercise. Controller Two, having established the bearing of the Bogey with his pointer, presses a height-finder button. An operator sitting next to the CIC officer then puts the height-finder radar antenna to search in that area. When its radar waves find the Bogey and bounce back the information, it is electronically translated into altitude. In this case it is 3,500 feet.

Commander Rowe informs Birch Tree,

[Continued on page 242]

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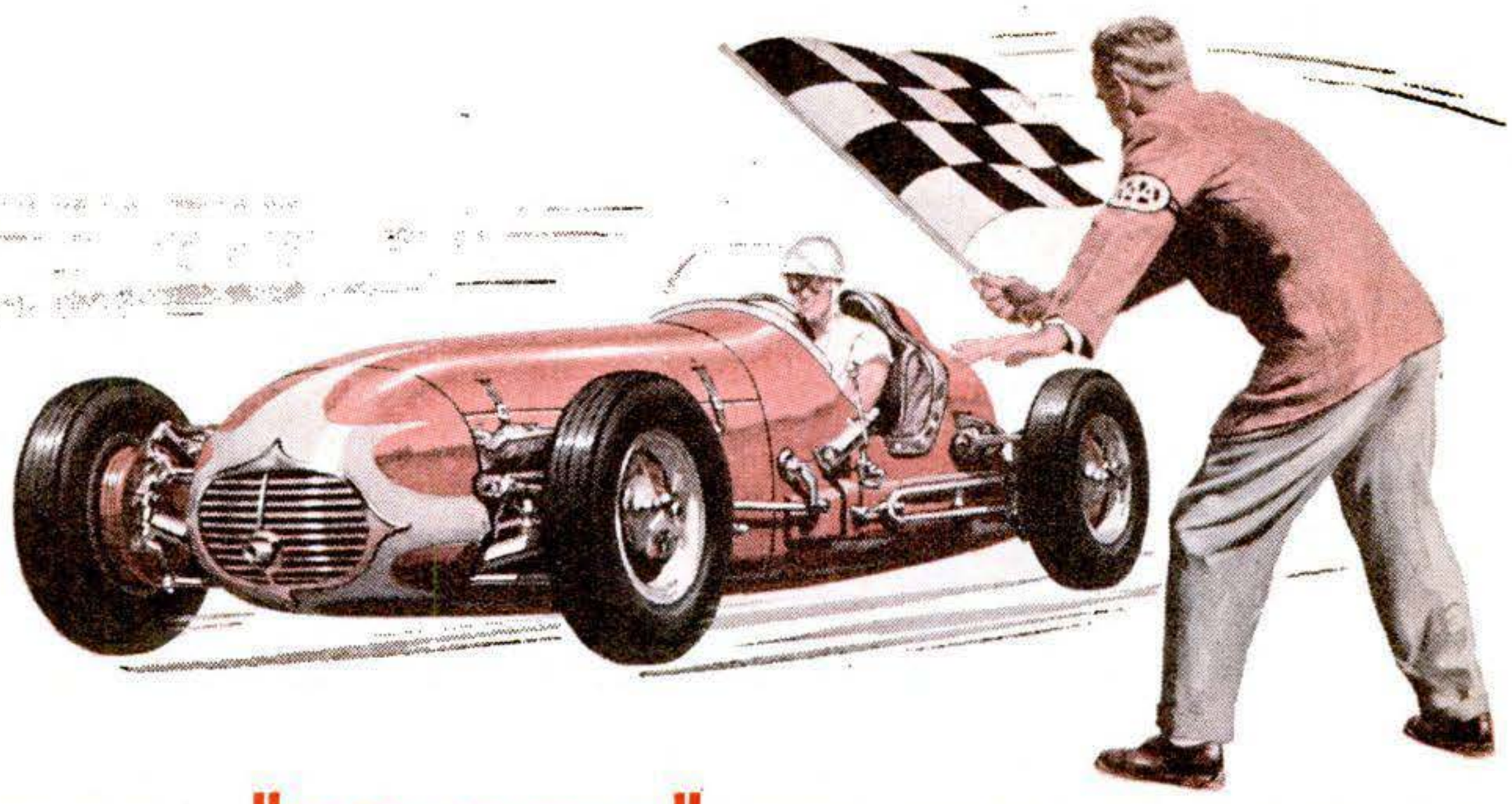
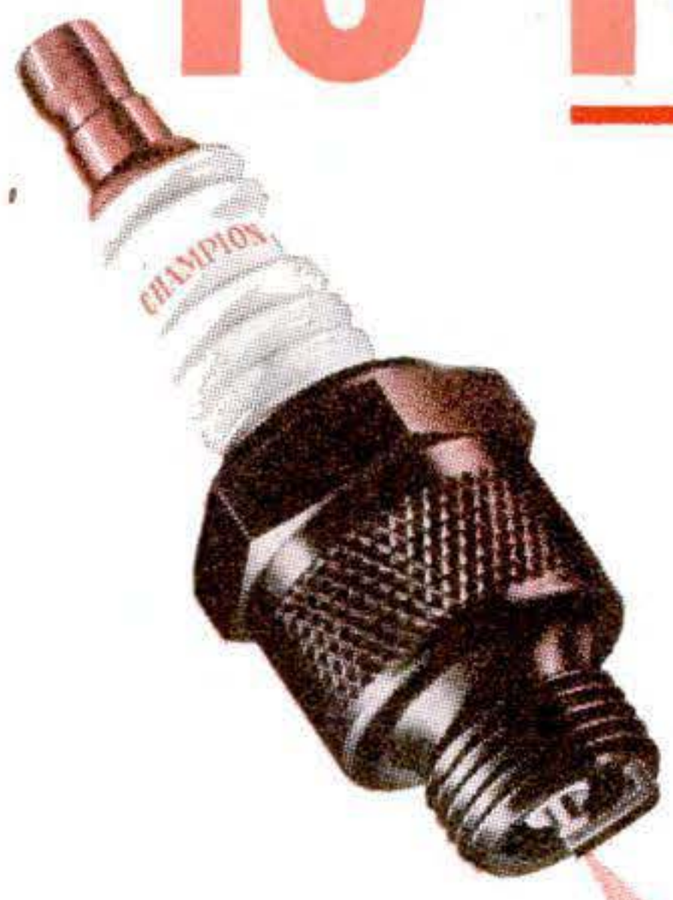


THE REAL "WINNER" AT INDIANAPOLIS

IS YOUR CAR!



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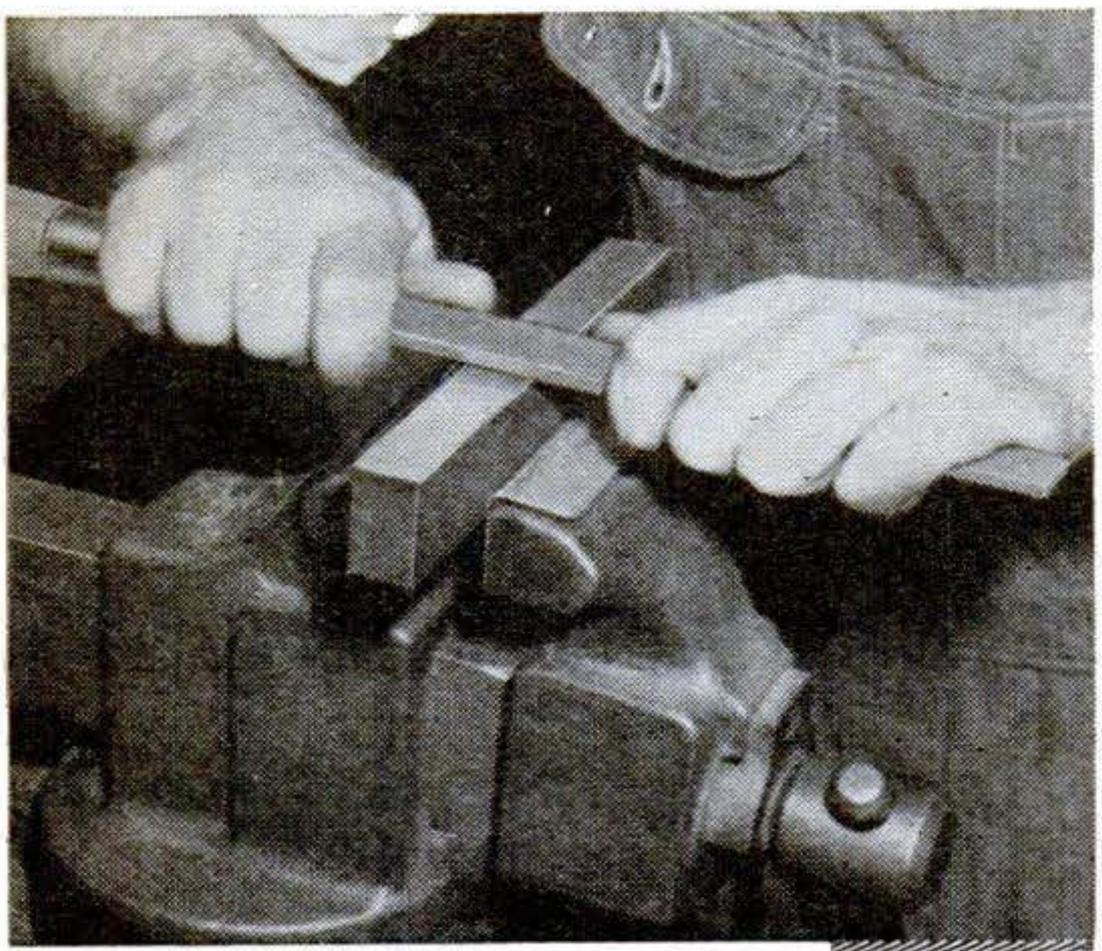

Drawfiling with a Nicholson or Black Diamond file (which is perfectly straight, accurately cut and of highest quality) produces a truly smooth, level surface, considerably finer in finish than does "straight" filing. Clamp the work in a vise, using zinc, copper or other soft metal "protectors" to prevent vise pressure from damaging work. Grasp the file firmly at each end and, without "rocking" it, alternately push and pull it sidewise across the work.

• ***THE FILE TO USE:*** Ordinarily, a Nicholson or Black Diamond Mill Bastard File (illustrated) is best for drawfiling. But where a greater amount of stock is to be removed—as on the edge of a metal sheet or plate—a Flat or Hand file (double-cut) will work faster. The resulting surface is not as smooth, so it may be necessary to follow up with the single-cut (Mill) file. *Your hardware dealer has both types.*

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[*Continued from page 240*]

which comes back, "Designate your Bogey 31. Intercept with Anyface One." Controller Two now watches his scope and directs Anyface One, the night jet interceptor, to his target, guiding him closer and closer.

"Hello, Anyface. This is Seven Baysides. Bogey now passing starboard to port at one o'clock, four miles, 500 feet above you. Punch."

Punch is the code word for the night interceptor plane to turn on his own intercept radar.

"Hello, Seven Baysides. This is Anyface One. Contact at Angels two. Splash."

The code word "splash" means that the jet fighter has the Bogey in his gun sights and technically has shot him down.

At 4:20 Strike Group Four Able, consisting of 20 propeller-driven fighters with 10 Banshee jet fighters for cover, is launched from our two aircraft carriers. We pick them up on our scopes and guide them through weather and onto their land targets.

We Splash 10 More Bogeys

Birch Tree launches another Combat Air Patrol for us. We continue routine barrier patrol, intercepting and splashing 10 more Bogeys.

We are relieved by an AEW B-17 at 3:15 a.m. Two hours later I hear our pilot: "Patuxent Tower, this is Seven Baysides, five miles northwest of field at 4,000 feet."

Patuxent advises us that the field is under instrument conditions and that we are to contact GCA (Ground Controlled Approach) for a landing.

We do. GCA acknowledges, instructs us to position for identification and brings us in for a normal radar landing after 17 hours in the air. END

Hidden Virtue

MAN may have more courage than woman but he doesn't get half the chance to show his backbone.—*Processing Equipment News.*

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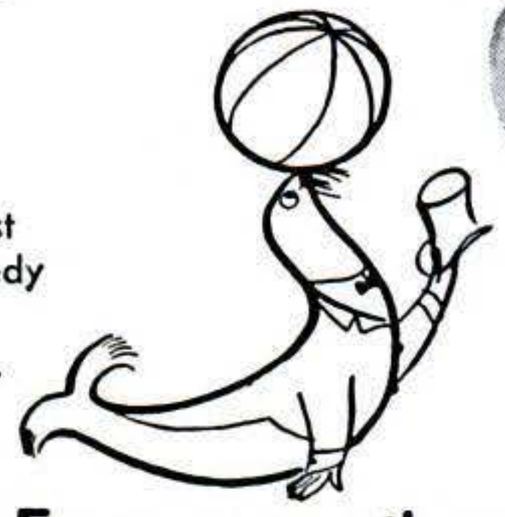


Exposures on the nose

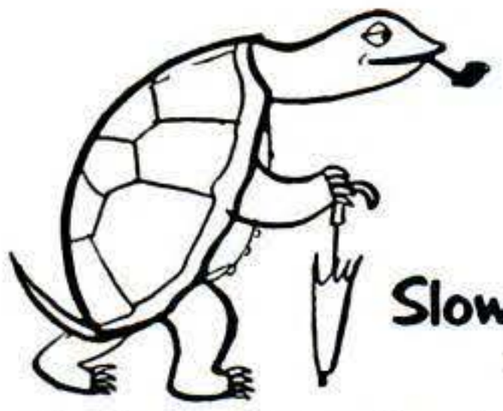
Built-in exposure guide takes out all the figuring, leaves only the fun . . . makes sure exposure's right every time!

Slips in a pocket

Light and compact enough to slip in a jacket pocket where it's always ready when action starts popping. Swings and points as easily as your own 12-gauge.

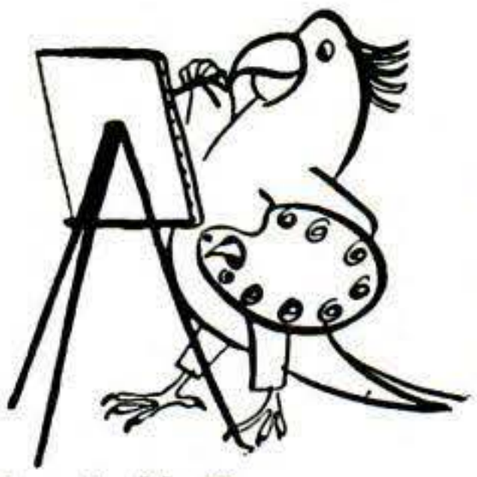
Tough...rugged

Die-cast aluminum body is built to take it. Your "Reliant" thrives on rough going—yet it's sweet-running as a custom-made reel.



Slow motion, too

Really cuts fast action down to size. Use it with any film, either lens, for those extra-detailed effects.



Color movies, of course

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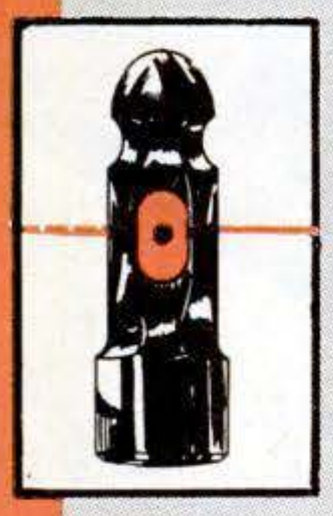

For *Safety,* the flared-end handle prevents slipping—the take-up screw keeps the head tight.

The *cone-shaped pein* spreads rivets evenly without mashing them. Do your next job with a Plumb—you'll finish faster.

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Anybody Can Build a House
[*Continued from page 119*]

a neighbor, a brother and a brother-in-law.

On April 5, 1952, the Poceks moved into their homemade house, a bit ahead of the average owner-builder, who takes from a year to a year and a quarter.

Pocek was a rarity in that he had no major problems in the course of erecting his home.

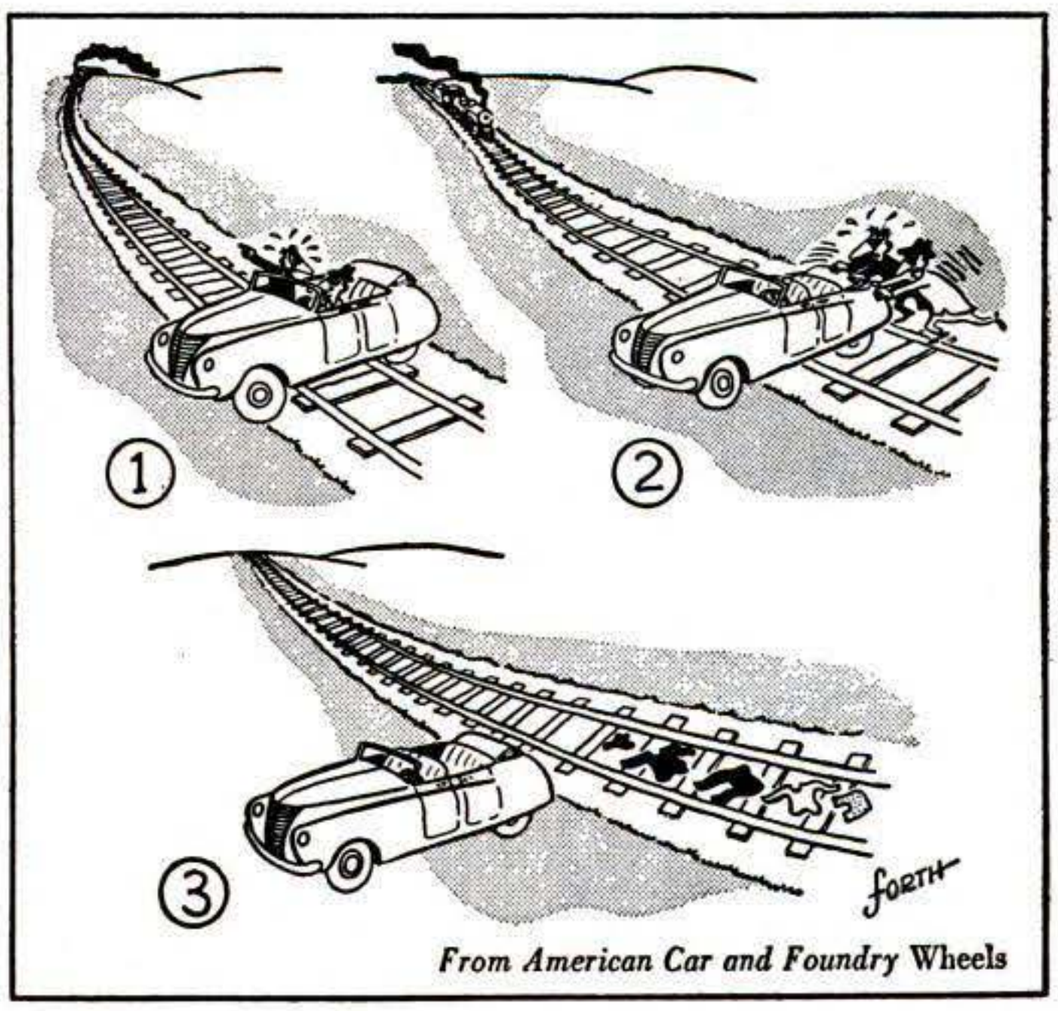
Nearly everyone, Oscar Maeder says, has trouble framing the roof. Trying to figure the length and angle of cut of the timbers causes universal headaches. Maeder can usually straighten the troubled builder out by rough drawings and counsel.

Before the Second Federal put an end forever to amateur plastering, one owner-builder assured Maeder that he could do his own.

For two weeks there was no report. Then, with misgivings, Maeder dropped by the man's house, climbed the stairs and looked in at the bathroom door.

"There was a heap of plaster about two feet high in the middle of the floor, and darned little on the walls and ceiling," says Maeder.

"I called my man, and no sooner had I spoken his name than he said loudly, 'All right, Maeder, you win. Go ahead and hire plasterers.' Then he added, a bit sheepishly, 'I was ashamed to tell you what had happened.'" END



From American Car and Foundry Wheels

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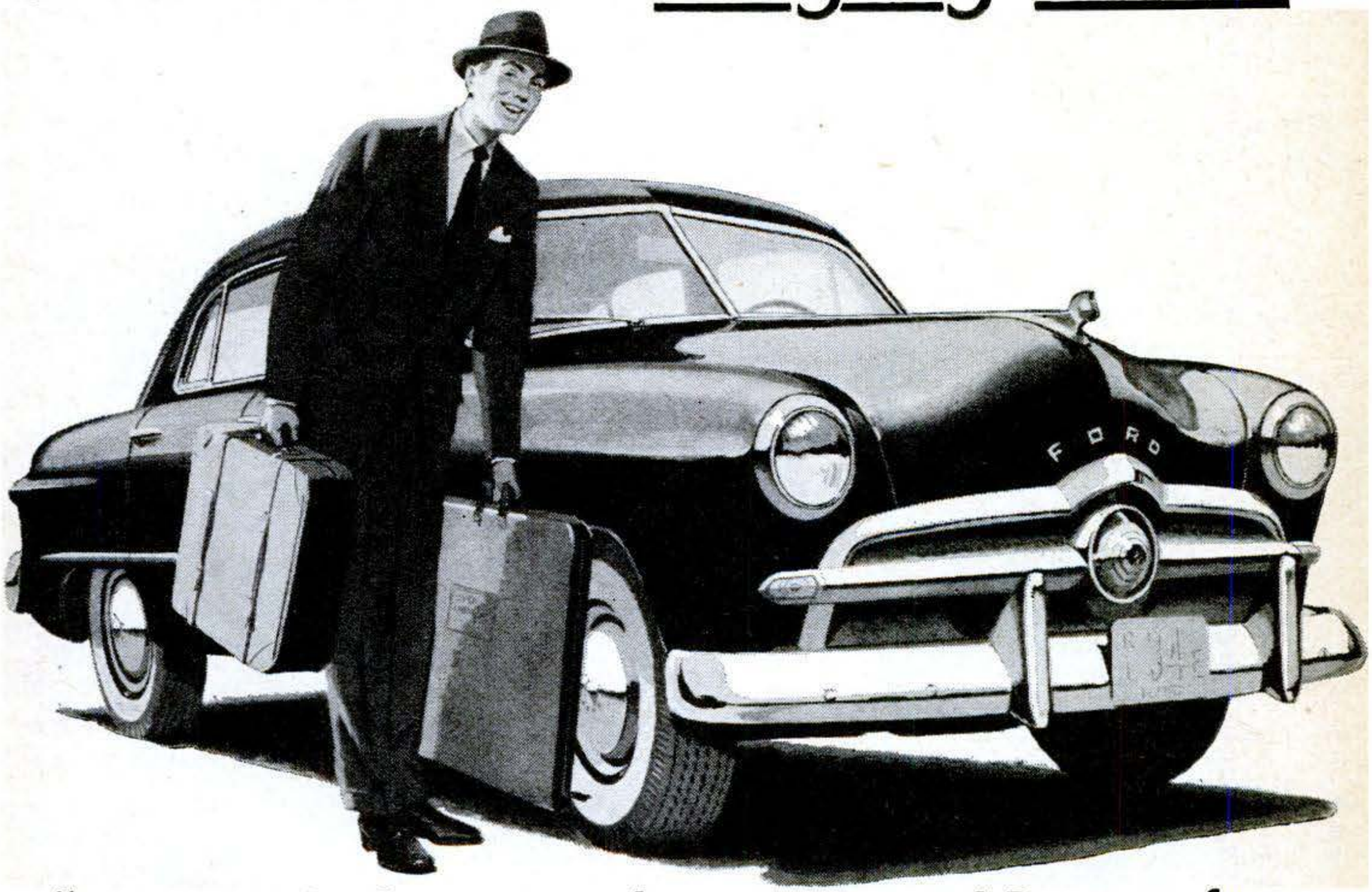
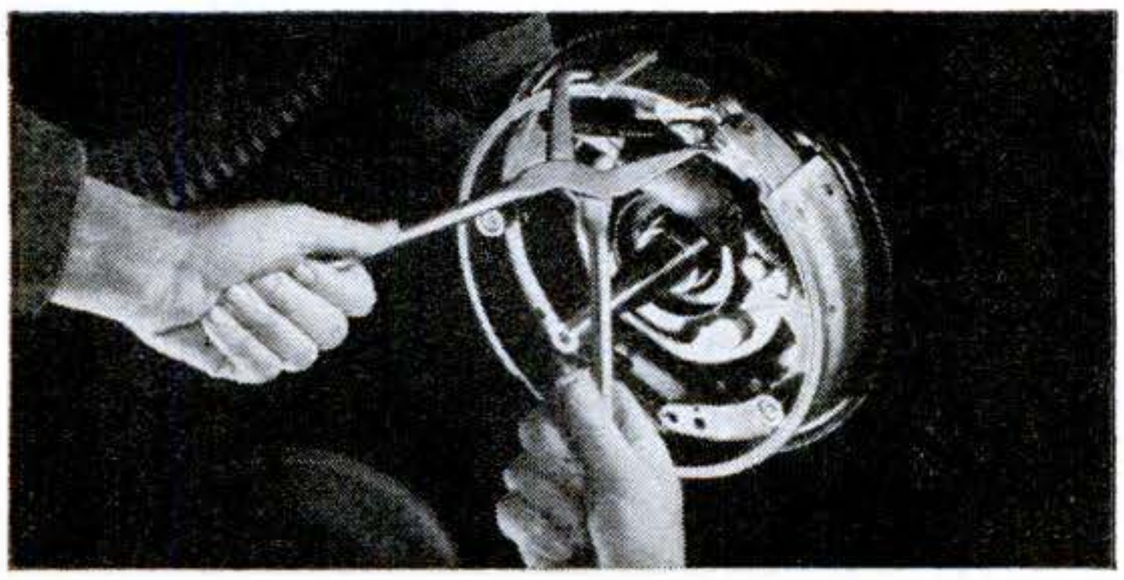
"13 cross-country trips and she's still singing sweet!"



"Sure, I've had to use replacement parts! But *not often*— because I've always insisted on GENUINE FORD PARTS!"



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Why risk disappointment when you are sure of satisfaction if SWP House Paint is used? There are substitute house paints that sell for less than SWP, but don't let that fool you! *Insist upon* SWP, and be *sure!*

Write for the free booklet, "The Truth About House Paint" . . . The Sherwin-Williams Co., 1206 Midland Building, Cleveland 1, Ohio.

Go to the store that displays this famous trademark

SHERWIN-WILLIAMS HOUSE PAINT

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SW-5310

Earthquakes Are His Hobby

[*Continued from page 137*]

When the tower sways with the earth, the short ends of the bars are held relatively motionless by the weighted cases. At the pen ends, the slight relative movements between bearing and anchor points are greatly magnified.

The bars are so linked and pivoted that one is sensitive to north-south movements, another to east-west movements, the center one to up and down motion.

Robinson can usually plot the epicenter of a quake within 10 miles. The very first jiggle tells the direction. East-west and north-south traces can be plotted together to pinpoint it.

Earthquake shocks have three distinct phases. The first one is a compression wave directly up to the earth's surface, which moves up and down in that locality. (Official records of the Tehachapi quake in 1952 put this movement as high as three feet.)

A secondary transverse wave goes through the underlying rock, while a third one travels through the surface crust. Since seismic waves move at five to seven miles a second, the time interval between these phases (which look different in a seismogram) establishes the distance to the epicenter.

House Is Wired for Quakes

To make sure he doesn't miss anything interesting, Robinson has a buzzer and lamp in the kitchen that signals any quake up to a certain minor intensity. More severe ones also set off a gong that rouses the house.

Living as he does in an earthquake belt, Robinson has a normal respect for the earth shocks. But even though he is San Diego's expert on the subject, he'd much rather record them from the mid-Pacific than in his own back yard. END

No Dunce, He

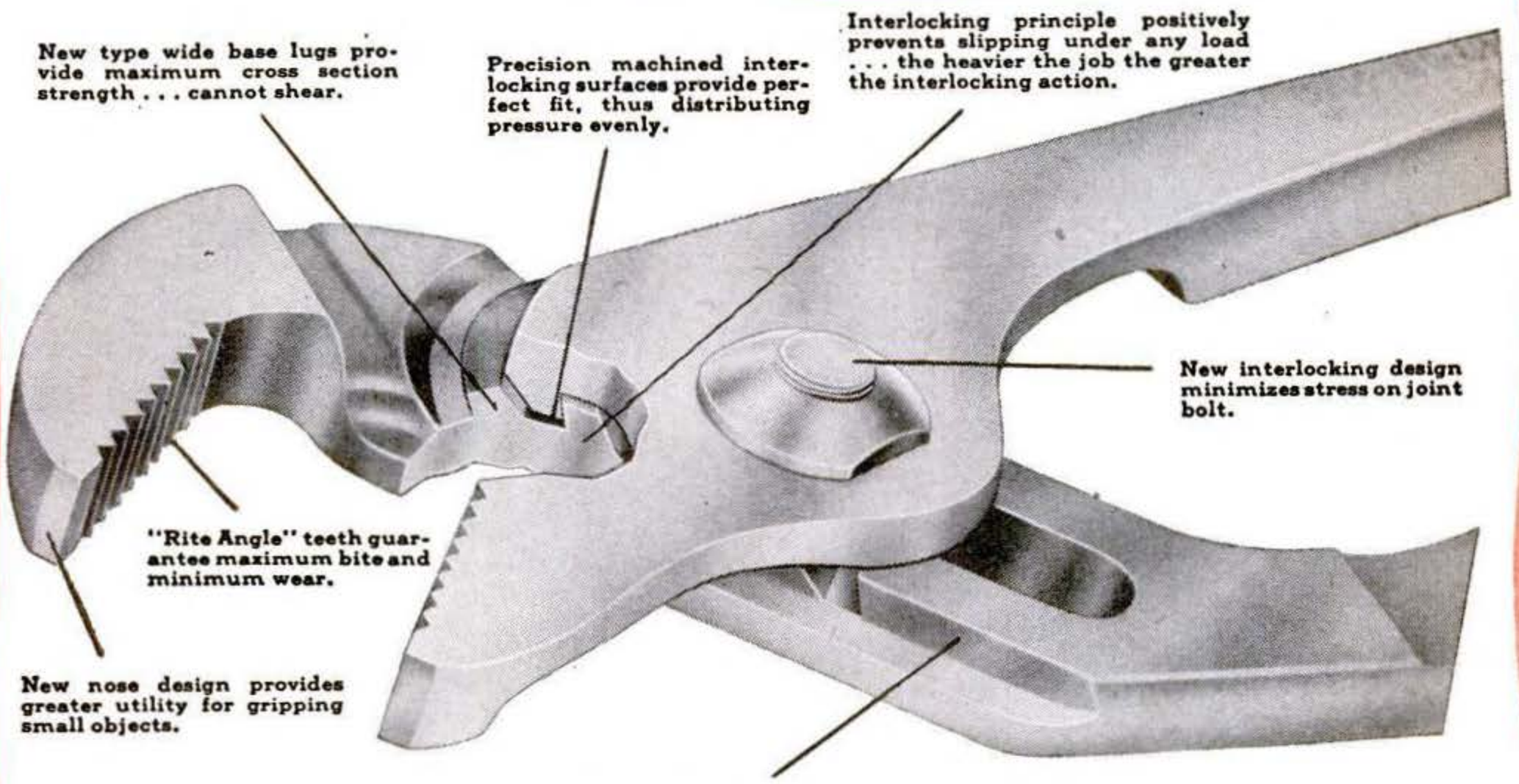
Teacher: "Class, what is a flood?"

Bright Boy: "It's a river that's too big for its bridges."—*L & N Magazine.*

The plier design that OBSOLETES all others

THE NEW No. 420 CHANNELLOCK PLIER

TRADE MARK REG. U. S. PATENT OFFICE



Channellock pliers are listed in the Yellow Pages of most Telephone Directories under "Tools"

Here's the new, improved Channellock Plier—bringing to you new features which offer more positive gripping, greater strength and longer wear. The undercut interlocking channel is the first really new idea in plier design in years. Engineering skill has developed a plier with new patented features which give you the newest, strongest, most practical plier you can buy. Here is a plier that will last for years! Channellock Pliers—made only by Champion DeArment Tool Company, Meadville, Pa.

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Gus Puts the Heat on an MG

[Continued from page 196]

he lighted the oxyacetylene torch, adjusted it to a medium-hot flame, and pushed the flaming tip into the end of the tailpipe. In a few seconds, dark gray smoke started to stream from the manifold end. Finally, when the tailpipe started to get cherry red, Gus reached down and shut off the acetylene and turned the oxygen full on. The smoke continued to stream from the other end of the pipe.

Gus Burns Out the Carbon

"If I'm lucky maybe we'll be able to burn the carbon out," explained Gus.

As the three watched, the cherry red section seemed to travel up the tailpipe, along the muffler and finally to the manifold section. In about 20 minutes there was no more smoke. Gus shut off the oxygen.

About a half-hour later, the MG's exhaust was back in place. Gus started the motor and it took the gas well. Evidently Gus's burning-out process had worked. Then came the final proof—a road test. The motor responded beautifully. On a deserted stretch of highway, Gus got the little car up to 85 without any urging.

And on Sunday morning, at breakfast, Gus got his thanks. An item in the local Sunday paper read:

LOCAL BANKER
WINS IN ROAD RACE

J. B. Barnes, president of the Empire Bank & Trust Co., took first place in his division of the sports-car road race held here yesterday. Mr. Barnes, virtually unknown in national sports-car activities, astonished a field of seasoned veterans by skillful maneuvering of his well-tuned MG around the sharp curves and 90-degree turns of the Mill Road course. Hitting a fast pace right from the start, Barnes took an early lead . . . END

Next month: Gus calls a close one.

Shutter Nut

AT A recent eclipse of the moon a college freshman arrived at the observatory with her camera. She said she was going to take a picture when the moon was entirely eclipsed. Someone remarked that she wouldn't get much of a picture, but she was unperturbed.

"Oh, don't worry. I have a flashlight attachment."—*The Wyatt Way.*

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with *one* direct-drive motor!

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COMPACT...a *complete*, big-capacity home workshop, (cuts 2½" deep, rips to center of 4-foot panel). Fits in a 3-square-foot area.

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DE WALT "Power Shop"

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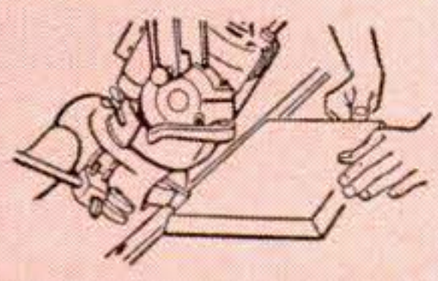
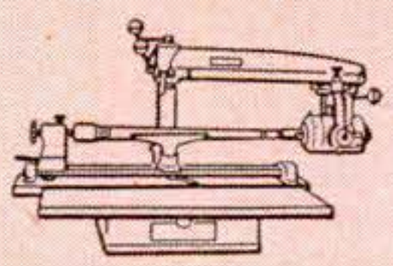
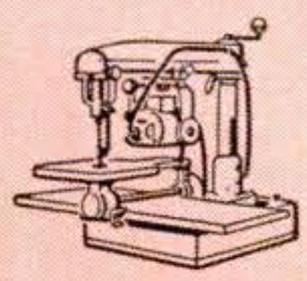


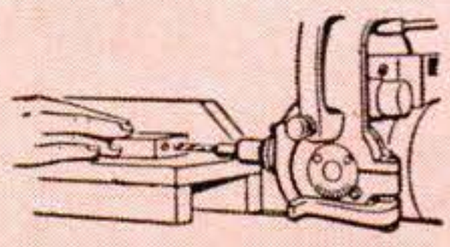
PROFESSIONAL SHAPER!



CRAFTSMAN'S LATHE!



BIG-CAPACITY JIG SAW!



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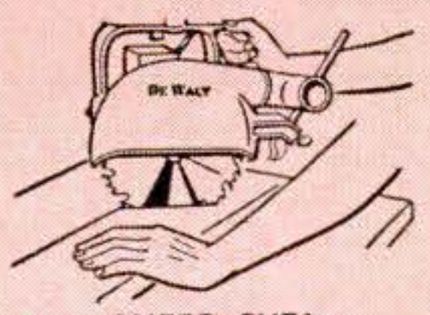
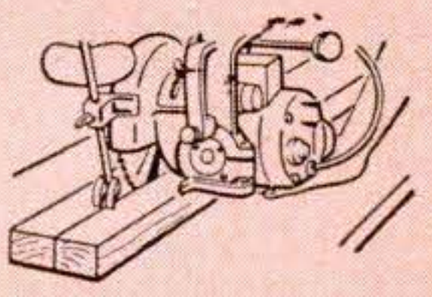
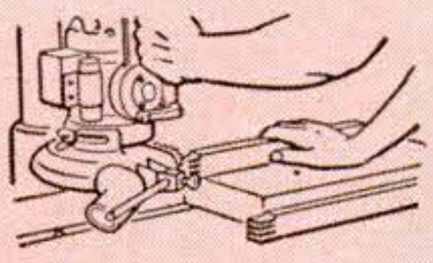
Makes every cut and joint!



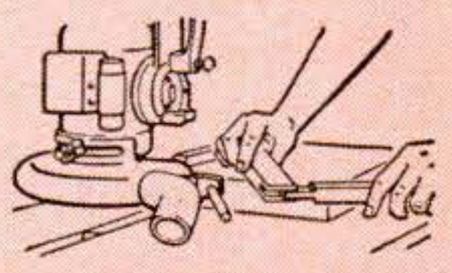
MITER CUT!



RIP CUT!



LOCK JOINT!



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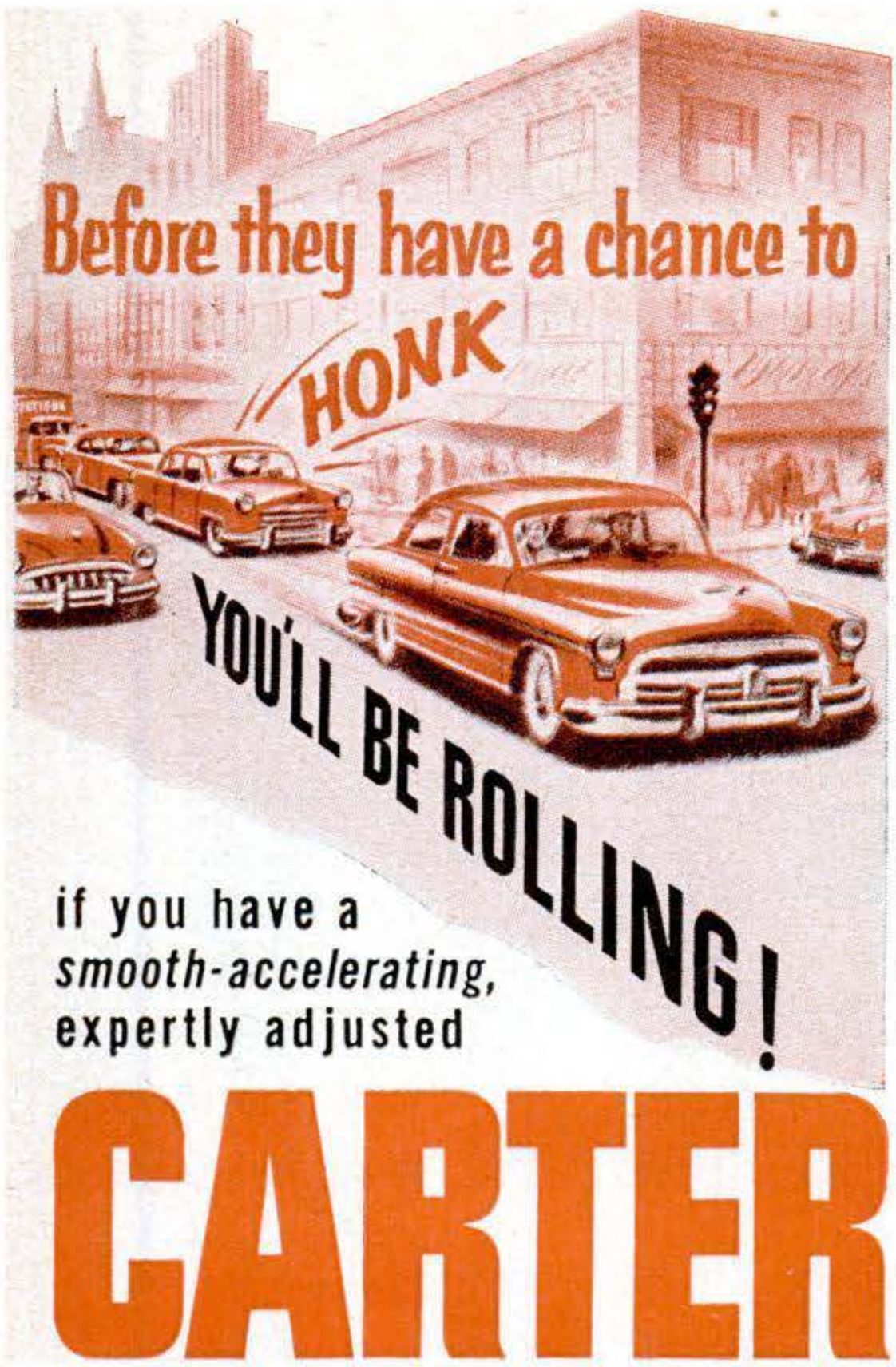

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CARTER CARBURETOR CORPORATION
St. Louis 7, Missouri
Division of American Car and Foundry Company

"Fill 'er Up with Fuel Oil"

[*Continued from page 84*]

Lest all this sound like something too good to be true, it's only fair to complete the list of the Diesel's faults. We already know that Diesels are noisy at idle and lack snap. They get more out of their fuel than a gasoline engine, but waste more on their own machinery. Their "friction losses" are greater because the moving components are heavier.

The Mercedes-Benz people may argue that point. They say the actual difference in weight between their Diesel and their gasoline engine of the same displacement is only 33 pounds. The two engines, in fact, use the same blocks and crankshafts. That may be true, but with all the necessary accessories aboard, the Diesel car weighs 120 pounds more than the gasoline car.

And the gasoline engine produces a quarter again more horsepower. To get the same horsepower with the Diesel would require a power plant even heavier. Diesels not only are slower, they have to be more rugged too.

The Doctor Is Pleased

Yet, Dr. Schmidt-Baeumler's Diesel chariot is perfectly satisfactory to him and—apparently—to a small but growing number of other buyers here in the United States.

Its size, an omen for the future in this day of rising fuel costs, gives the Diesel a quarter of a ton less dead weight than the lightest of the Ford, Chevrolet or Plymouth sedans. As for the engine, about the only other objection to it is what might happen when the car was driven into a parking lot.

Imagine saying to the attendant: "If you have to move my car, you turn this key here. Then you turn this handle and press this, wait until the light turns red, turn the handle farther—oh well, never mind. If you need me, I'll be in that restaurant across the street." END

The Hard Way

SOME people learn traffic rules by accident.—*Viking Vacuum.*

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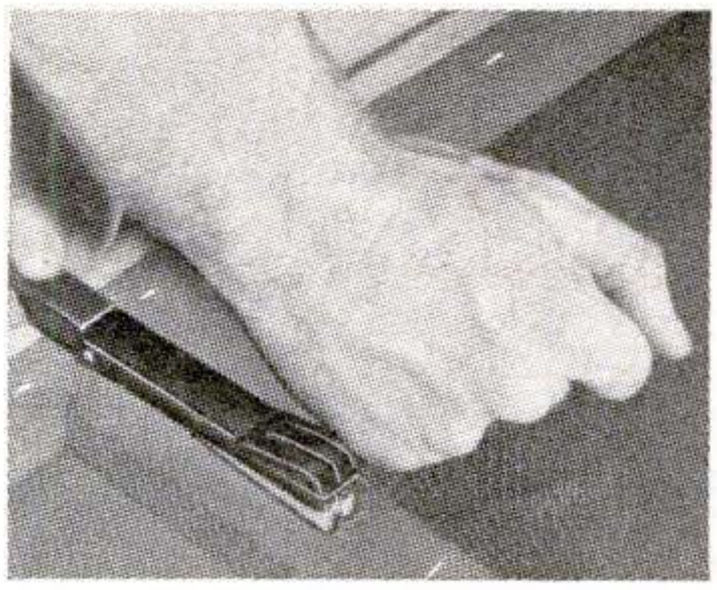
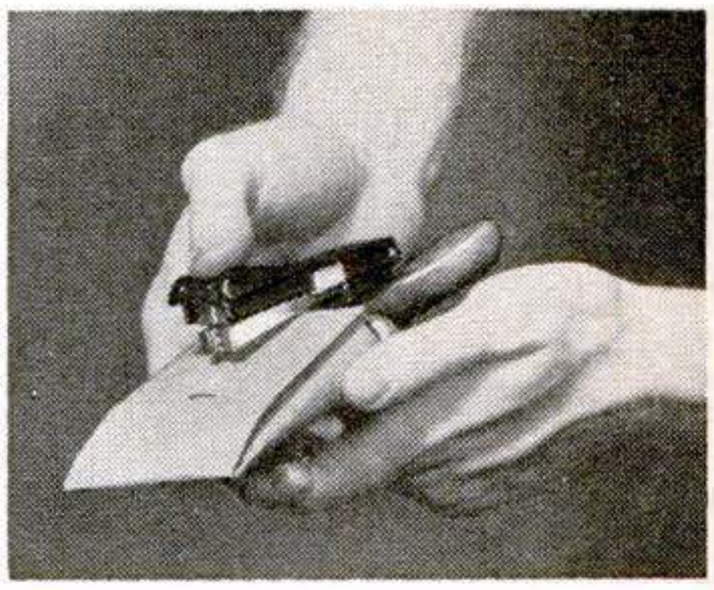
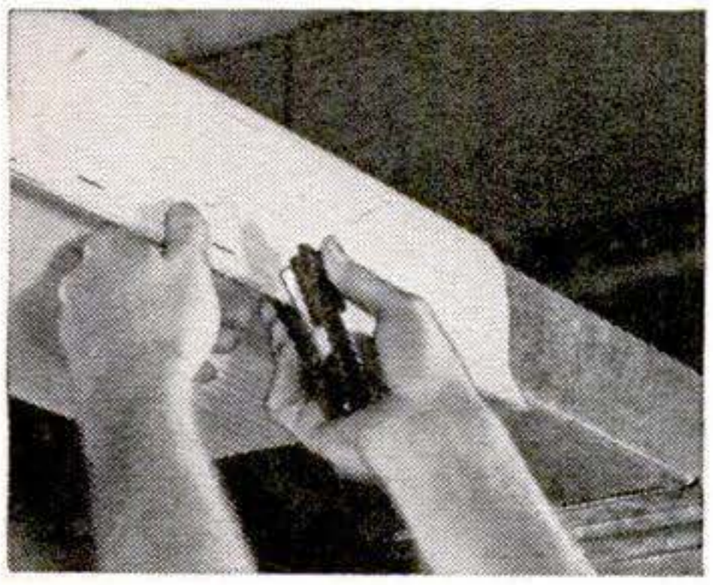
FASTEN IT FASTER



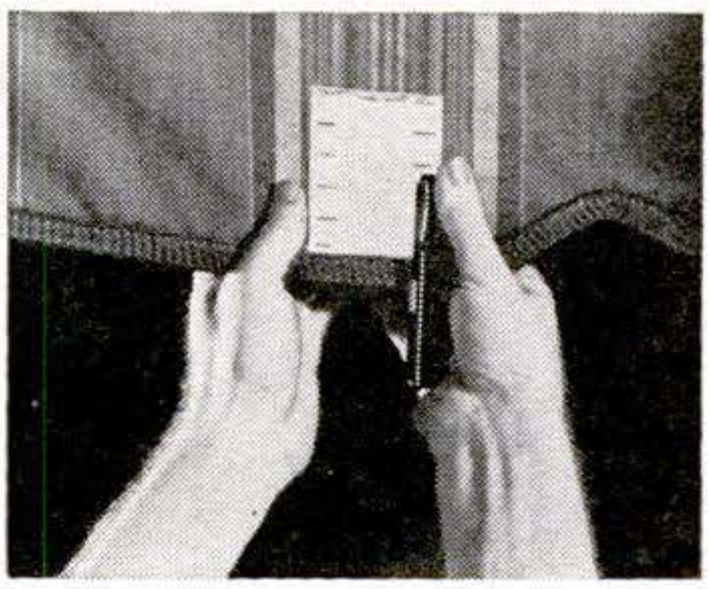
PLASTIC SCREENING can be tacked to frames quickly and easily with *Bostitch B-8* used as tacker.



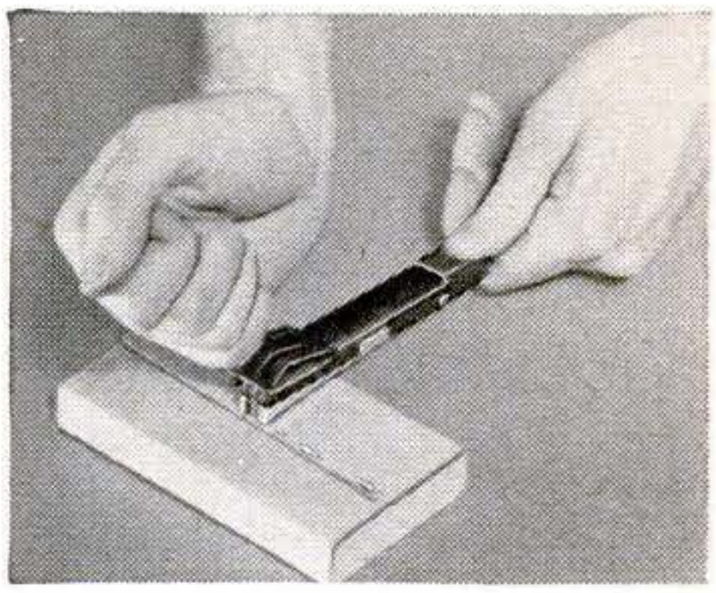
PUT WRAPS on your paint brushes between jobs. *Bostitch B-8* has removable base for getting into tight places.



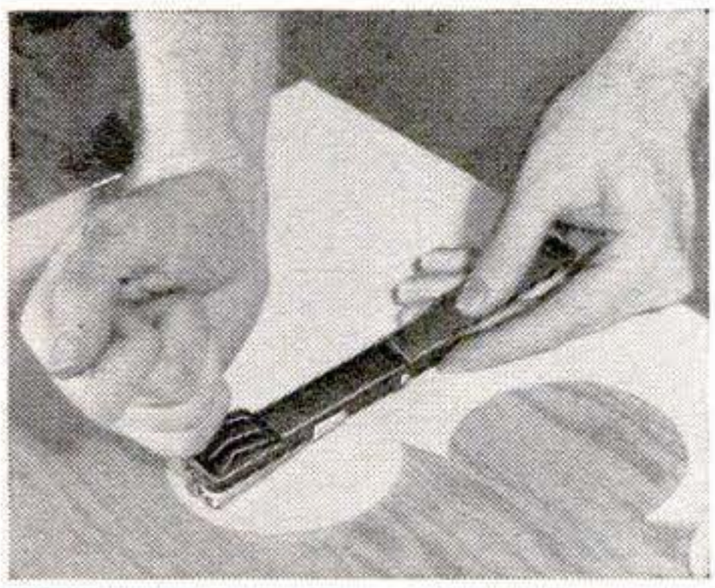
STOP HEAT LOSS by covering warm air ducts with asbestos paper. *Bostitch B-8* makes it an easy, one-night project.



TORN CANVAS on awnings or furniture can be mended by stapling parts with *Bostitch B-8.*



SANDING BLOCKS are easy to make when you tack sandpaper to blocks of scrap lumber with *Bostitch B-8.*



KEEP PATTERNS IN PLACE by stapling them to material to be cut. Lift them easily with *Bostitch B-8's* staple remover.

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● You'd soon realize how much an oil-pumping engine costs, if you bought all that wasted oil at one time.

Every extra quart is a danger signal—and so are loss of power and smoke from the exhaust. They're symptoms of worn-out piston rings. And the sooner you replace those rings, the more money you'll save.

As your engine gets older, the cylinders wear tapered and out-of-round. The engine runs hotter because of accumulations in the cooling system. It needs more oil on the cylinder walls.

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Hastings rings are nationally known for their ability to stop oil-pumping, check cylinder wear, restore engine performance.

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TOUGH but oh so GENTLE

TOUGH ON OIL-PUMPING
GENTLE ON CYLINDER WALLS

HASTINGS

STEEL-VENT PISTON RINGS

Regular or Chrome-Faced

Can We Tame the H-Bomb?

[Continued from page 99]

Los Alamos Scientific Laboratory, at Cornell University, and elsewhere in this country. Some have been on far from a miniature scale.

At Los Alamos they have been carried on outdoors in tubes up to 50 or 60 feet long, which are blown up at each trial. Shaped charges are reported to have been used in these tests, of which only a few details have been made public.

An eight-foot steel "shock tube" at Cornell packs no mean punch. When gas pressure bursts a diaphragm near one end, a shock wave races through it at up to 17 times the speed of sound. Developed by Dr. Arthur Kantrowitz and associates for guided-missile and aeronautical studies, supported by the Office of Naval Research, this non-secret installation offers a visitor a first-hand view of these waves' awesome effect.

Heat Evaporated Metal

When a shock wave struck a brass fitting of 1½-inch diameter in this tube, a quarter-inch length of the solid metal was evaporated by the heat—in about 1/10,000th of a second! Gases in the tube become brilliantly luminous during a shock wave's passage, as in the French experiments.

Maximum temperature reached in his own tests exceeds 32,000 degrees F., Dr. Kantrowitz estimates. This may be far from the theoretical limit. By directing shock waves through a narrowing passage, other experiments of his suggest, their energy could be focused on a shrinking area. As this area approached a mathematical point, the temperature figure should soar almost indefinitely.

How We'd Use H-Power

If any of the current experiments should tame the H-bomb's power, just what would we do with it?

Atomic blasting comes first to mind. Dr. J. Robert Oppenheimer, wartime head of the Los Alamos laboratory, predicted the possibility in 1947. Later,

[Continued on page 254]

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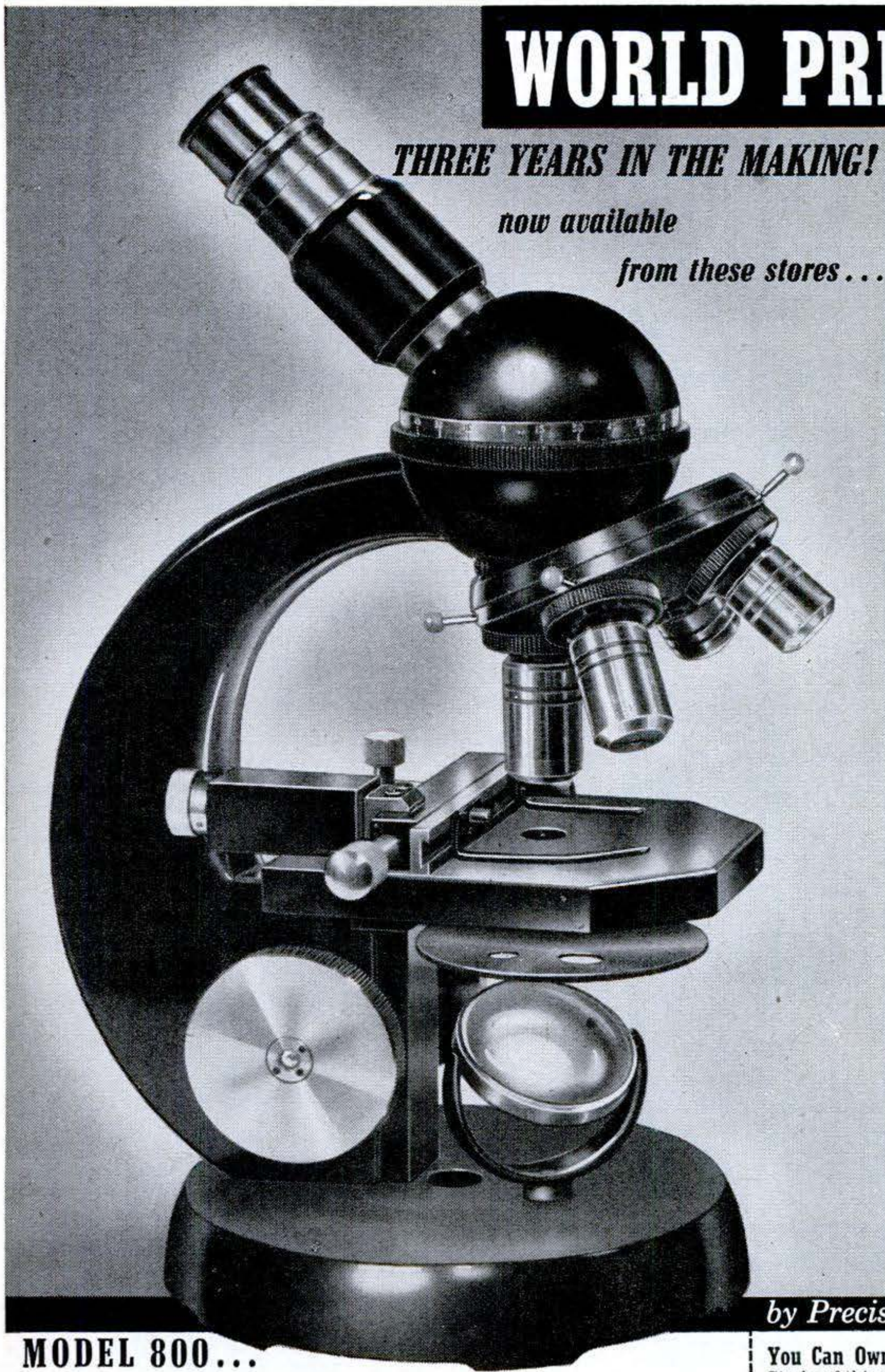

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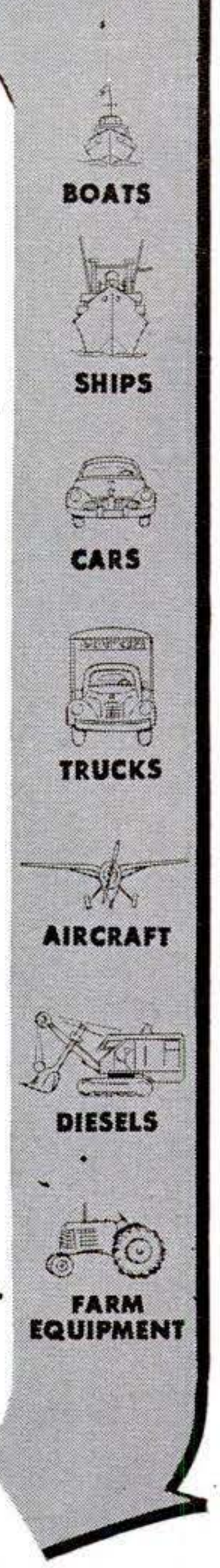

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Can We Tame the H-Bomb?

[Continued from page 252]

after the first Soviet A-bomb, Russian sources claimed that atomic explosions were being used to move mountains and hew an irrigation canal in Turkestan. Few took these stories seriously—but such feats could become reality with H-explosives. Figures are startling.

If unofficial guesses are right, an H-bomb equivalent to some 4,000,000 tons of TNT was exploded at Eniwetok last November. Now, suppose this enormous energy could be expended in driblets. By standard blasting practice, 240,000 tons of ordinary high explosive would have been more than ample to blast away the 240,000,000 cubic yards of material excavated in building the Panama Canal, *even if it had all been solid rock.* And so it turns out that a whole Panama Canal could be dug with a small fraction of a single H-bomb's power!

H-Powered Machines Seen

Could H-power run vehicles and machines? Conceivably it might be harnessed in jet and rocket engines—and perhaps even to drive the turbines of power plants. Steam boilers whose fuel explodes, instead of tamely burning, have actually been designed (PSM, Nov. '32, p. 40).

Smelting ores for their metals, and high-temperature scientific research, are still other imaginable possibilities.

Thus may be reversed the qualms of physicists who said they hoped the H-bomb wouldn't work, but were afraid it would, when its construction was ordered three years ago. For in the end, capturing the fire of the sun may prove more of a blessing than a curse to mankind—and harnessing it for constructive ends may rank as the crowning triumph of atomic scientists. END

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LEGALLY the husband is the head of the family and the pedestrian has the right of way. Both are fairly safe unless they try to exercise those rights.—*Pure Oil News.*

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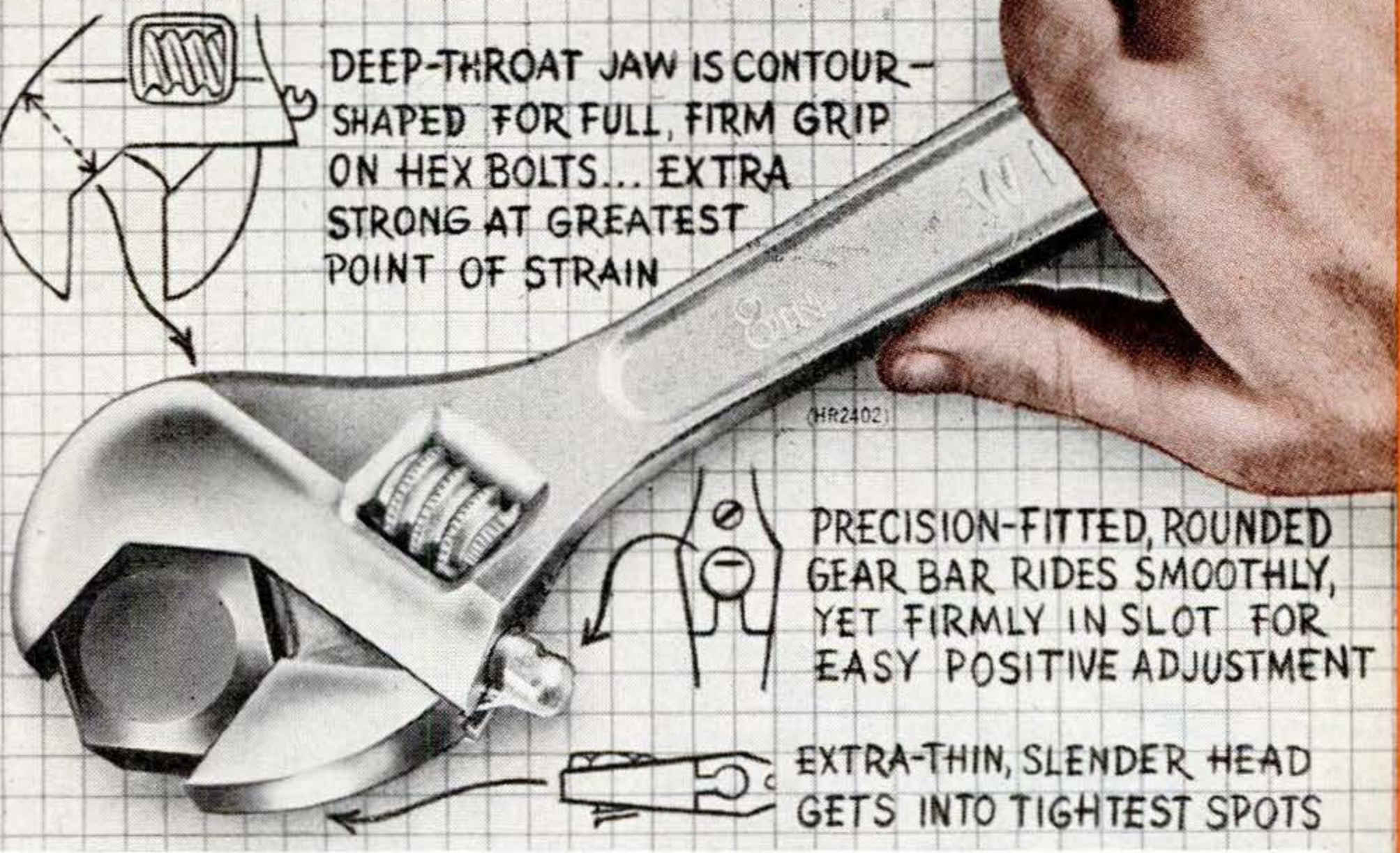

(HR2402)

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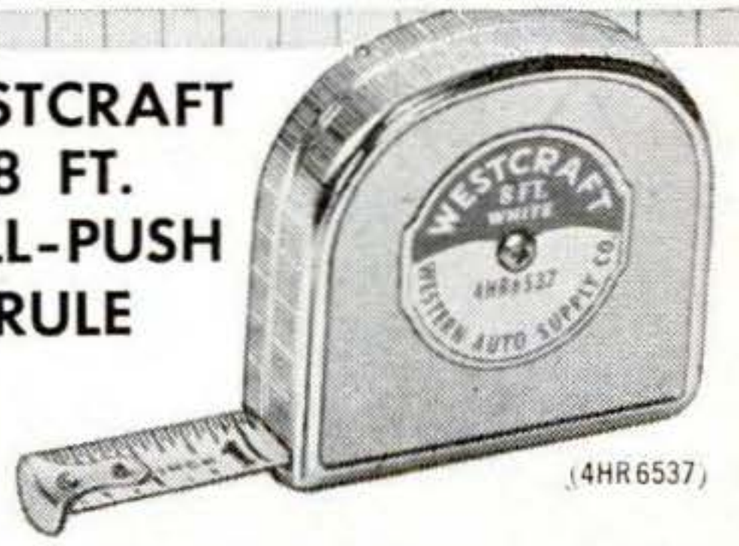

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New Queen Dazzles the Motor World

[*Continued from page 112*]

Oyster Bay, N. Y., Peggy's western hemisphere distributors, would be pleased to let you have one for $17,500 to $19,500. She'll have four carbs, magneto ignition, and an easy 135-m.p.h. cruise. You'll have your choice of swank bodies by various French and Italian coachmakers. Compression ratios, transmission and rear-end ratios, and seat dimensions will all be tailored to your taste. This price is roughly comparable to that of such other fancies as Ferrari and Bentley.

Whether there's a U. S. market for a two-passenger car costing as much as four or five Caddies is unknown. Ricart, an ex-Alfa Romeo engineer, and ENASA, a respected manufacturer of buses, evidently think so. In selling gilded sports cars the competition record is vital, of course, and ENASA has entered a team of Peggies in this month's Le Mans race, the sports-car world series. The railbirds concede Peggy a fine chance but point out any new design is handicapped in racing against "debugged" machines.

What's it like to drive? If you are an old hand at sports cars, Peggy is purely exhilarating; if you customarily drive an elderly Plymouth, you may tend to become unsoldered. (After a session with a Pegaso, this writer drove his carefully tuned Merc home with a distinct impression of waltzing with a drugged fat lady.)

Climb behind the almost-vertical steering wheel and you'll find yourself in an artfully calculated cockpit. As in combat aircraft, there is sufficient room for a six-footer to do the needful but no space to loll around in indolent poses. The seat is bucketed enough to keep your bottom from drifting on a hard turn, and the padded side ledge locates your left shoulder. Loosen a knurled collar on the steering column, slide the wheel in and out until it feels right, and lock it there.

Cockpit check. Drop your right arm naturally from the wheel and it will come onto a finger-indented knob atop the stubby shift lever. Study the shift lay-

[*Continued on page 258*]

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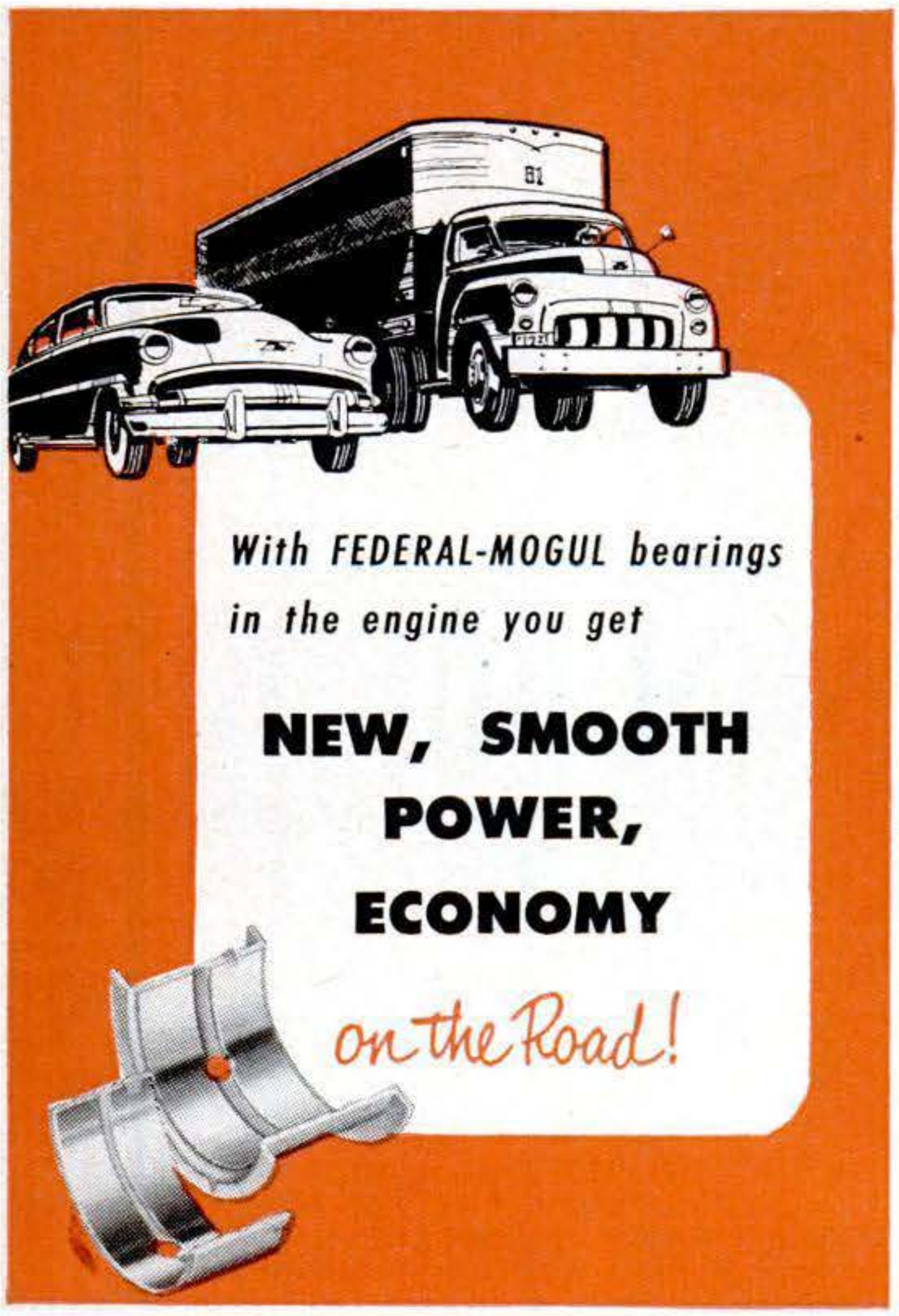

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Ask Your Mechanic!

New Queen Dazzles the Motor World

[Continued from page 256]

out that is cut into the top of the knob. Spring pressure centers the lever where second gear is a straight punch and third a straight yank; at right are reverse and low, at left are fourth and fifth. Now get your feet oriented—the stiff clutch, the firm brake, the big, long-travel accelerator, which looks like the clutch or brake.

Hit the key under the spiral arrow symbol and fire up. Wait a few minutes for the "Temp. Agua" and "Temp. Aceite" pointers to break away from their pins, an interval you can spend doping out the metric-system Spanish on the gauges. The clock, ammeter, and "Gasolina" dials give no trouble. On the tachometer, note where the needle will fall at ranges above 4,000 r.p.m., where the engine really leans into it. At the speedometer, mentally prefabricate a few handy kilometers-to-miles conversions—100 k.p.h. is a bit over 60, 150 k.p.h. is around 93, and 180 k.p.h. is too fast for your aging bones.

Glance at the "Temp. Aceite" and "Presion Aceite" dials to make sure that the oil temperature and pressure are coming right. Jazz the gas very lightly and notice how the revs rocket up instantly, with no split-second gasp at all, and how the twin pipes give out an authoritative yawp.

Roll it. Slip into low and ease off. (If you don't gentle it, the first few starts will give you a cockeyed feeling that somebody behind is coming up fast and braking hard to keep from smacking you—but it's really just your own wheelspin.) Climb up through gears to third or fourth and be very wary of over-steering.

Peggy steers so fast that even sharp curves seem to be negotiated by wheel pressure, rather than actual displacement of the wheel rim. And be on guard against your pot-hole-avoiding reflex. That much wheel turn is apt to end you up going back where you came from.

Plainly she's no car for women or kids—driving it down to the corner for a pack of cigarettes would be a little like flying a jet to the barbershop. This is not at all

[Continued on page 260]

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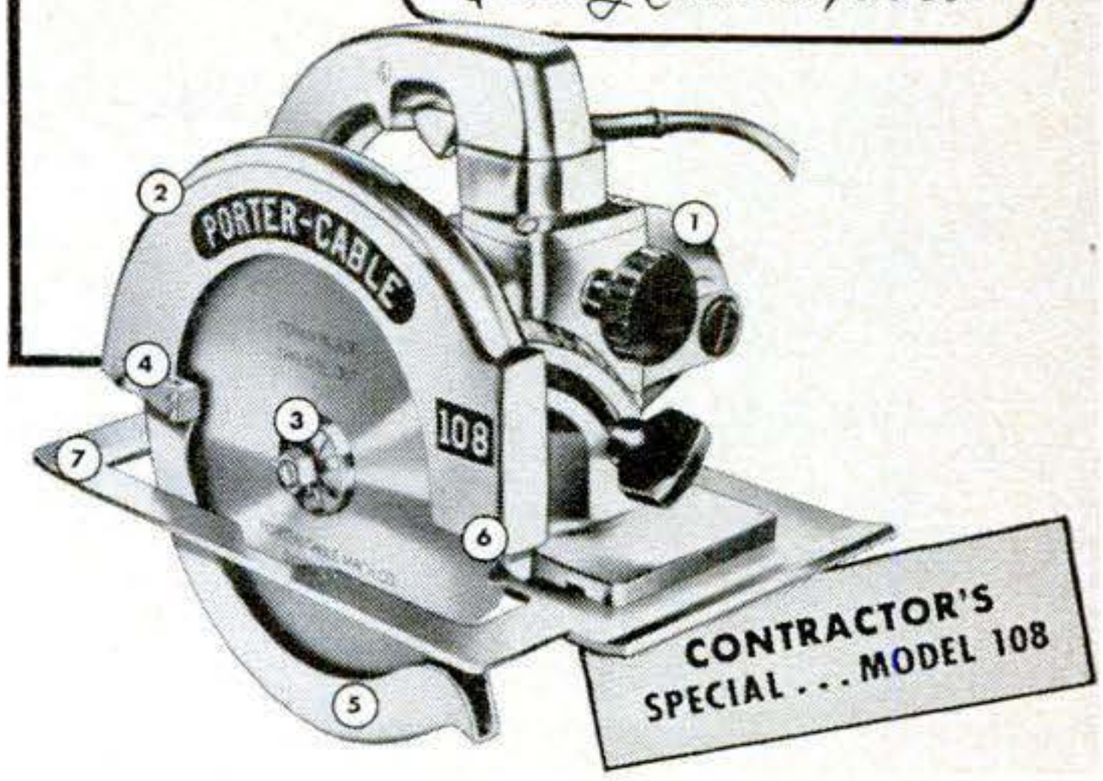

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New Queen Dazzles the Motor World

[Continued from page 258]

like the ordinary sedan that rather softly mulls over your recommendations on where to point and how fast to go. This is more a machine that nervously embodies your own reflexes, and has a wildly heightened response to your own muscles. Think of 90 m.p.h. and (whee) you're doing it; think of that curve ahead and (whee) you're around it.

Now work Peggy around some increasingly harder turns, feeding gas as you go. Notice how slick she is at road-keeping and cornering. Curve-speed combinations that would roll a stock product into a crumpled ball don't even bring tire noise or lean. Even if you do manage to break the wheels loose, a touch of power or an infinitesimal easing of steering pressure ties her right down again. She takes curves as easily as the white line on the road.

The ride is good, smoother than that of most sports cars. She's firm but doesn't pound on washboard or holes. There is little pitch, astonishingly little considering the wheelbase is eight inches shorter than a Model T Ford's. Shave into that turn ahead, off the concrete, off the rough edge of the macadam shoulder. She smoothly takes blips without bottoming.

Now perhaps you might feel out that engine a bit. As you wind it up the accelerator stays sensitive; in fourth or fifth gear at 150 k.p.h., quick pressure on the gas will still jerk your head back. In the reaches above 4,500 r.p.m. that four-cam engine begins to sing, and the blower joins in an octave or so higher, and you idiotically chime in *wheeeeeee!* still another octave up. Give her a few hard applications of brake and savor the smell of hot castor oil.

Peggy is a remarkably able car. If you like that kind of thing, better peer into that teapot on the mantel. END

Meeting of Minds

Two psychiatrists met on the street, and one said to the other:

"You're fine, how am I?"—*The Right Hand.*

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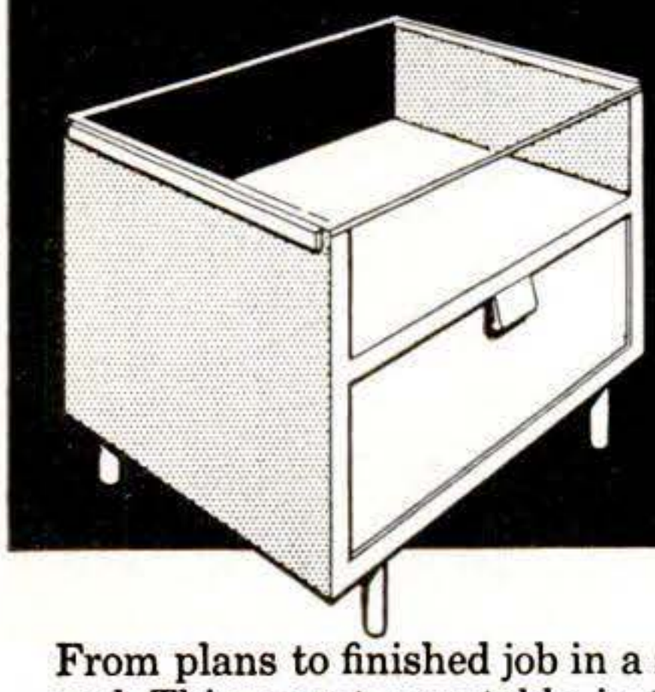
Modern End Table

DESIGNED BY NORMAN CHERNER



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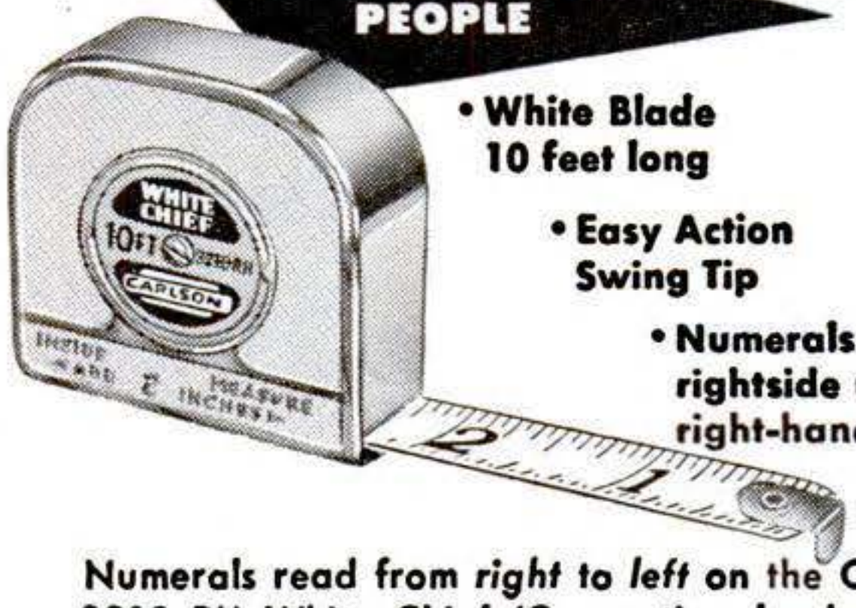

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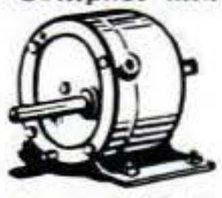

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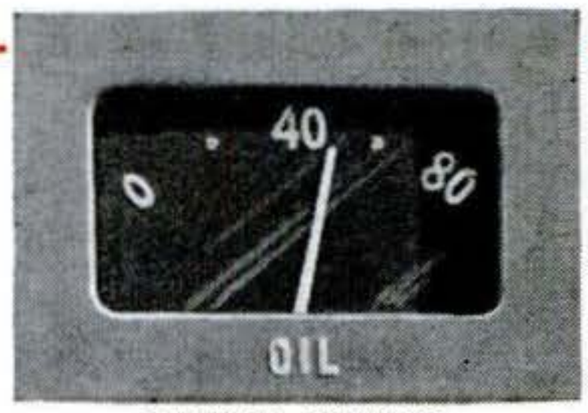

CHECK OIL PRESSURE

Glance at your oil gauge when starting engine, and at intervals while driving. Below-normal reading may indicate leakage, very dangerously low oil level, or pump trouble. Stop before lubrication failure seriously damages your engine! *Warning:* Your oil gauge can register "normal" even though crankcase oil level is below danger mark.

CHECK OIL LEVEL

Check the oil level whenever you gas up. Oil level is as vital as oil pressure; and *only* the dip stick shows you if there's plenty of oil in the crankcase. Oil consumption varies with speed and temperature; and there's always the possibility of leakage. To be safe rather than sorry, check dip stick frequently.

CHECK OIL FILTER

Keep a clean Purolator* Refill on the job. You need a good filter to keep the road dust, hard carbon and sludge that get into the oil stream from harming delicate engine parts. In time, your filter loads up . . . gets so clogged it can't keep up its money-saving work. *Before* that happens, get a new Purolator Micronic*—with 10 times more filtering area than ordinary types. Purolators are specified on more makes of cars than any other filter. Refills cost as little as $1.60 . . . take just a few minutes to install.

*Reg. U. S. Pat. Off

Check your oil filter every time you change your oil

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World's finest **OIL FILTER**

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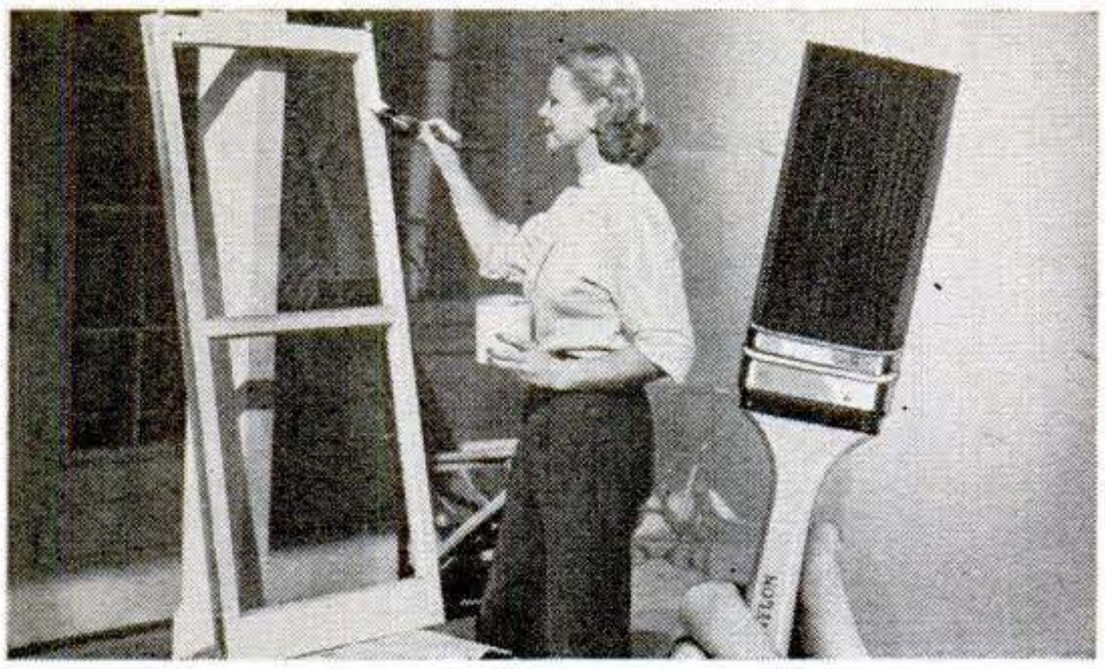
Pointers for Home Painters

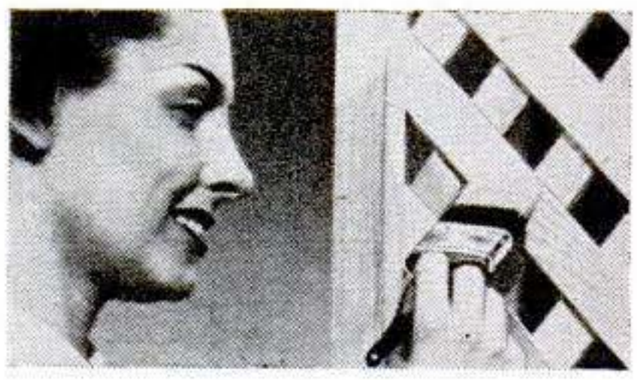


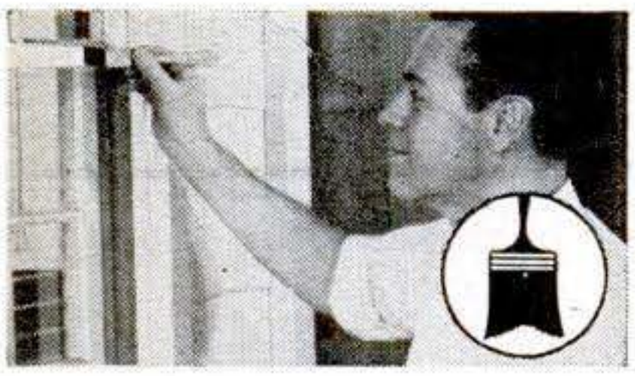
Choose the right brush for the job!

When you're painting window frames, screens or other narrow areas, the right brush to use is a sash brush. Sash brushes—either flat or oval-shaped—are designed for the job . . . help you get better results. And a brush with bristles of Du Pont nylon makes trim work easier . . . neater.

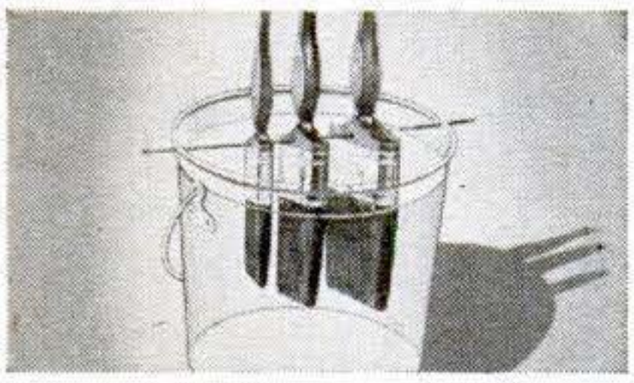
When painting windows, protect glass with a piece of cardboard or masking tape. Leave window slightly open during drying, so it won't stick shut.

When painting latticework, fences, radiators, always do the hard-to-get-at areas first. This saves you time, trouble and a lot of cleaning up . . . means better work.





When painting edgewise on narrow surfaces, use a sash brush. It's designed for the job. Using a large brush causes "fingering" (see insert), ruins the brush.



Clean brushes with thinner after daily use. Suspend brush in thinner overnight. Bristle tips should not touch bottom of can. Work out thinner before repainting.

For best results use NYLON PAINT BRUSHES

JOB AFTER JOB, you'll get best results with a well-tipped nylon paint brush. Durable Du Pont nylon bristles paint smoother . . . are clean and sanitary . . . never get brittle . . . don't break off even under the roughest treatment. And nylon bristles last from 3 to 5 times longer than ordinary bristles. Leading manufacturers make nylon paint brushes in all types and sizes. Look for the name NYLON on the handle. Be sure to pick the size brush designed for the job.

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. . . through Chemistry

The best brushes have
DU PONT NYLON BRISTLES

HANDIEST CABINET EVER MADE
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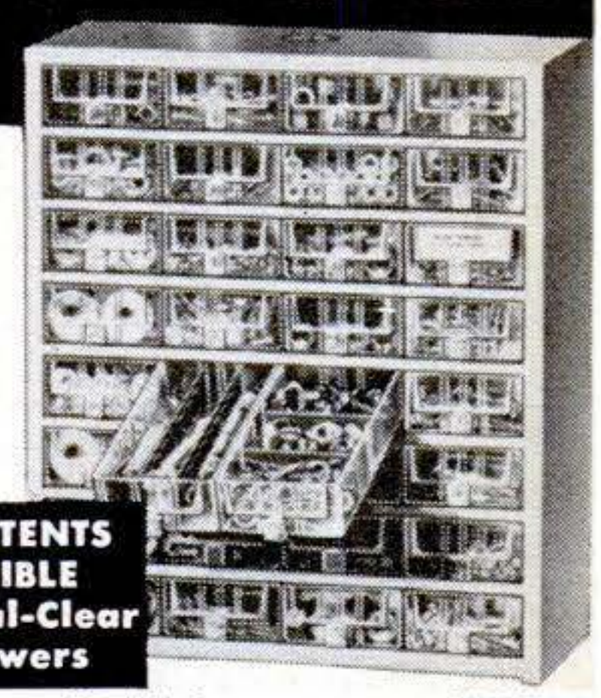

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CONTENTS VISIBLE Crystal-Clear Drawers

32-drawer illustrated

15¼" high
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6" deep

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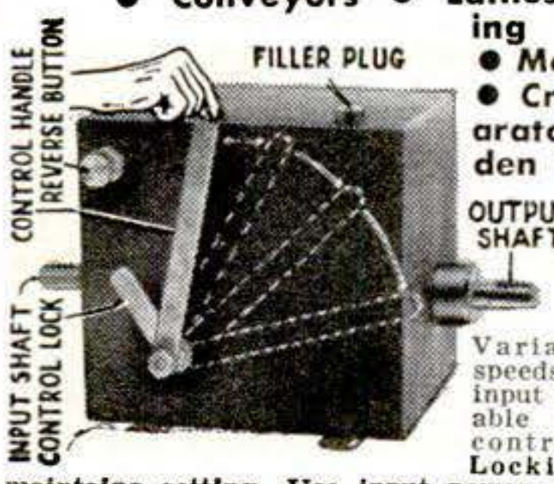

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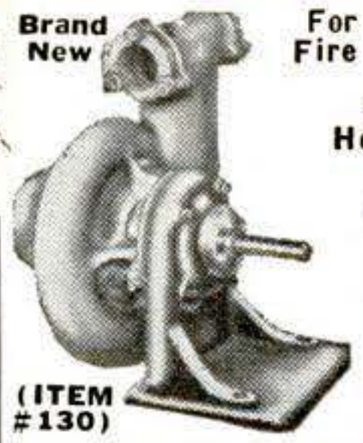

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Suction Lift	Head Pressure	Gal. Per Min.	H.P.	R.P.M.
10'	75'	260	6.0	3500
10'	65'	200	5.2	3500
10'	80'	40	1.5	2500
10'	50'	140	5.0	3500
10'	30'	100	3.0	2500

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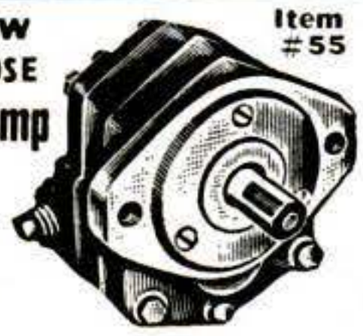

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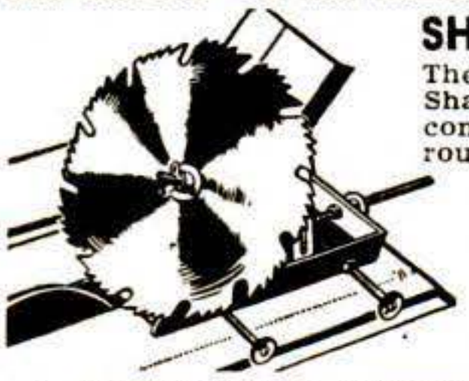

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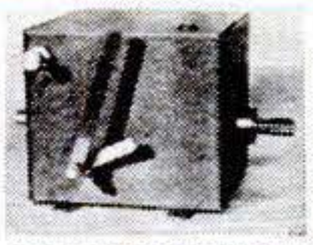

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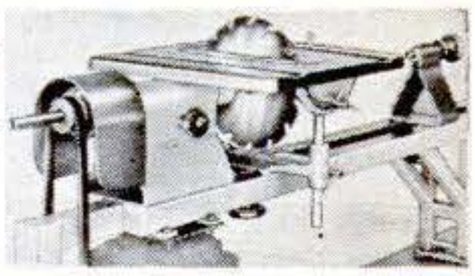

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SET 33L 10 different size H. S. Drills 1/2" to 1-3/16".. **$14.50**
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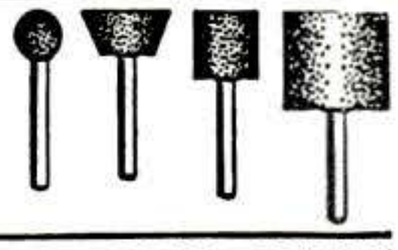

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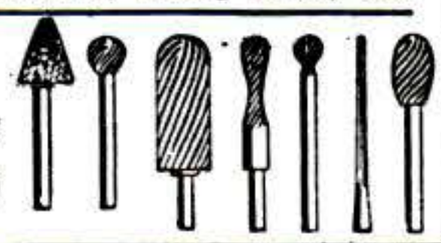

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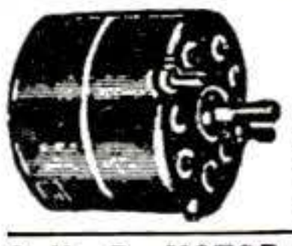

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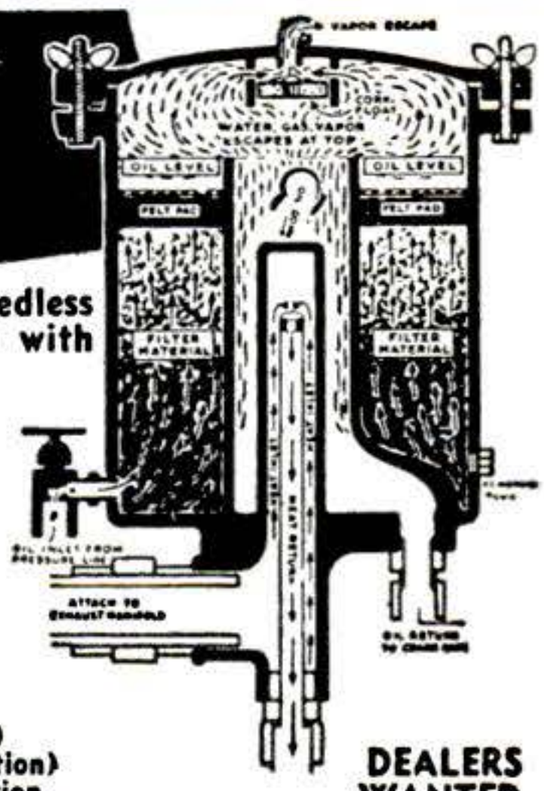

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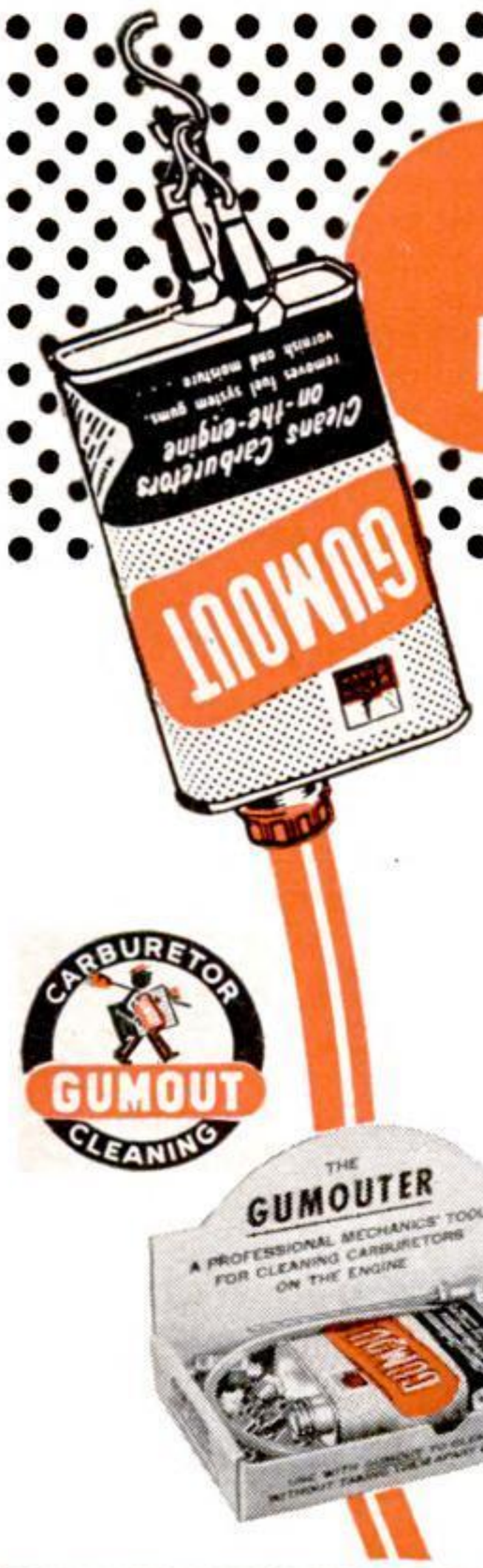

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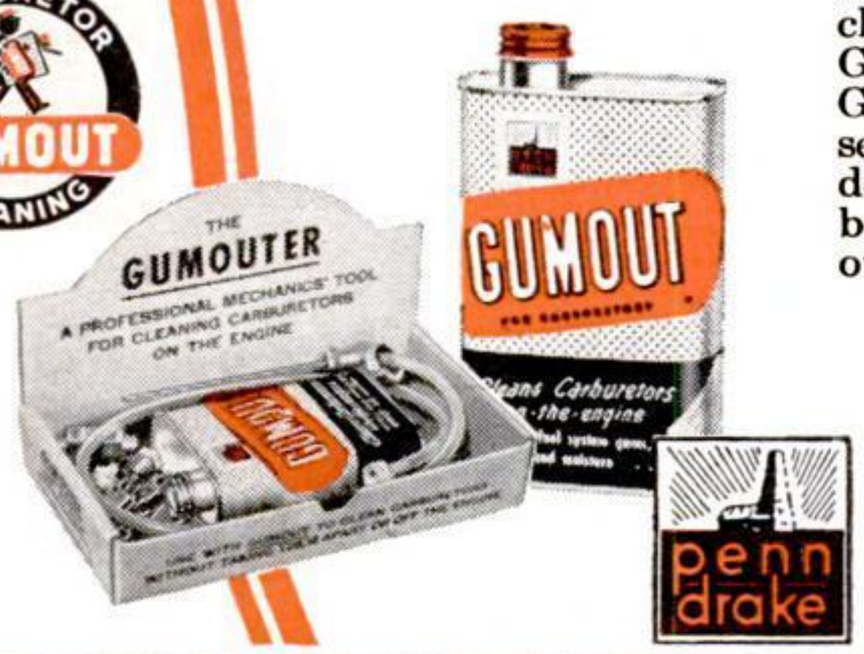

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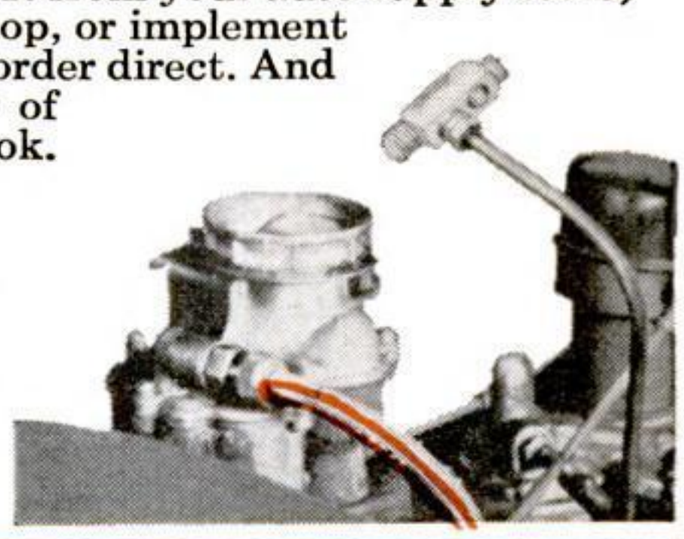

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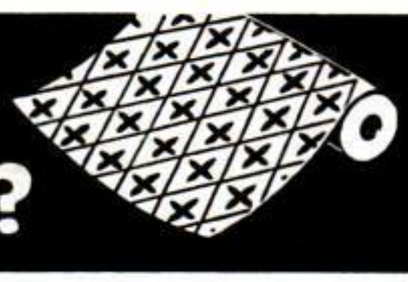

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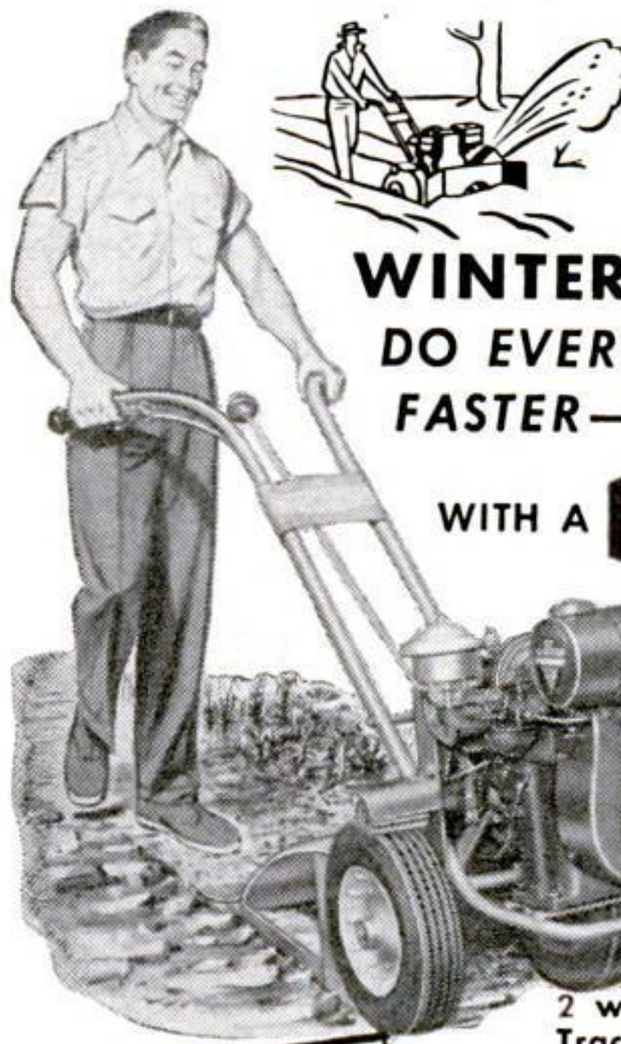

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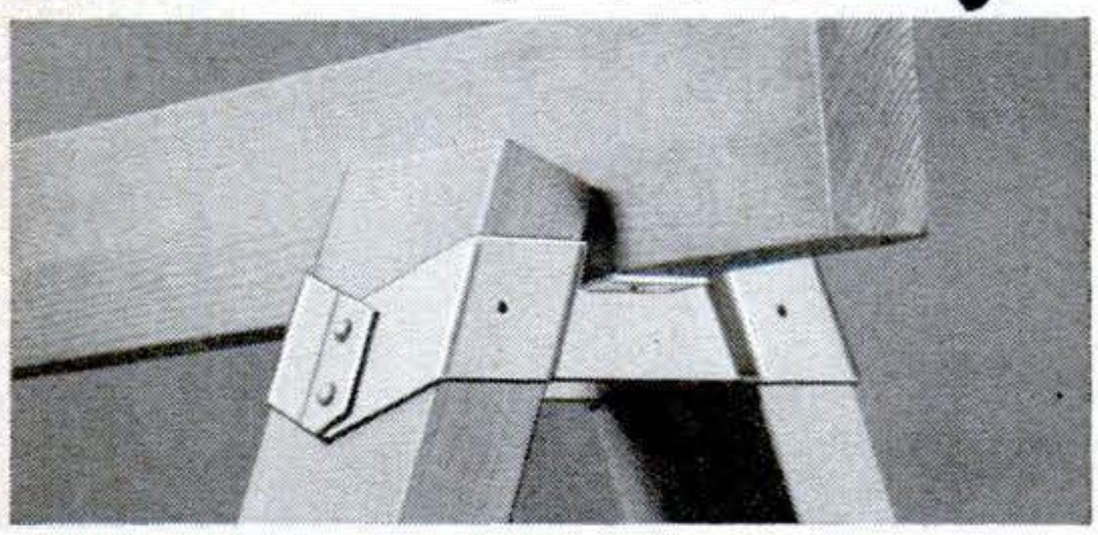

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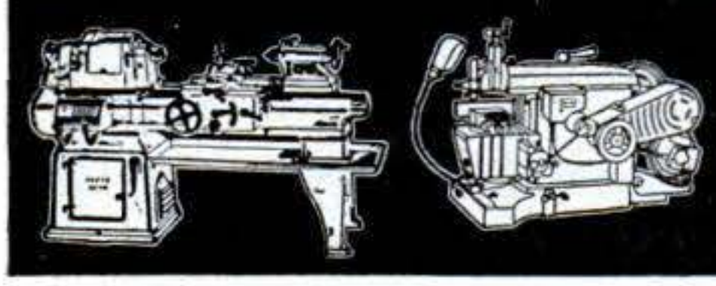

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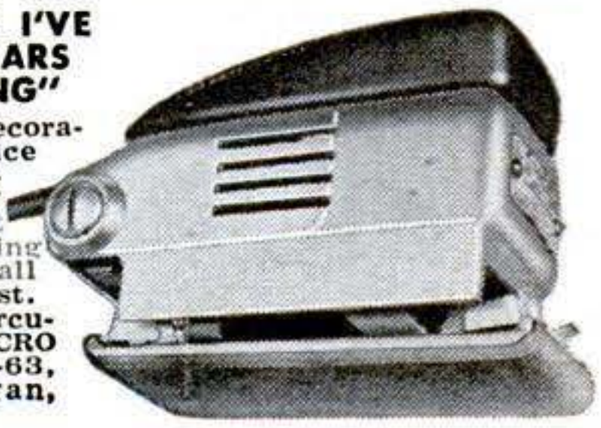

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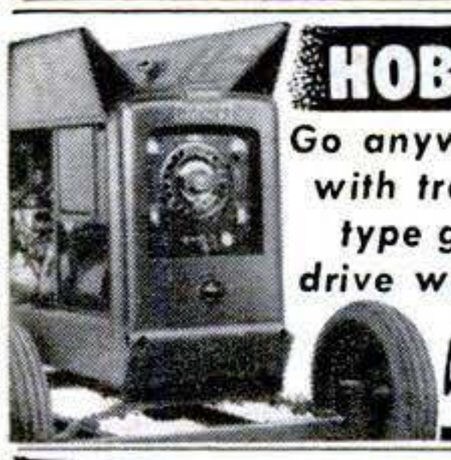

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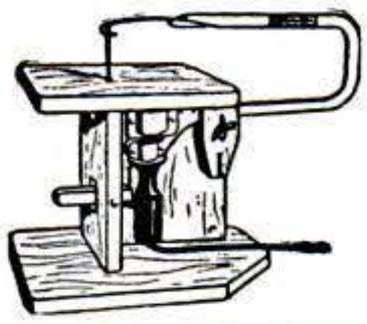

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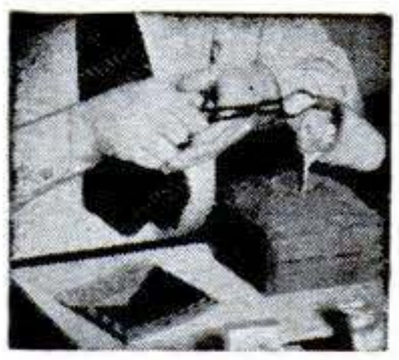

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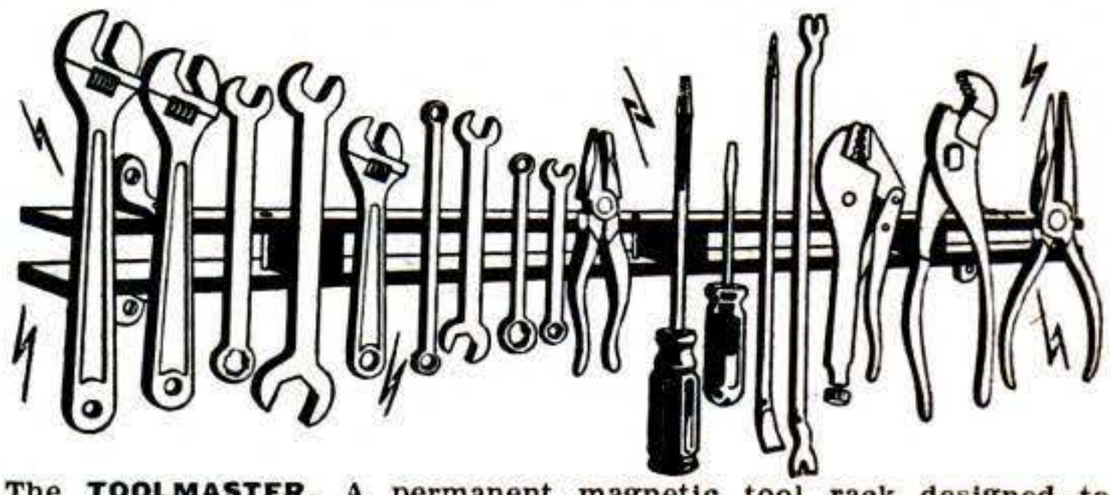

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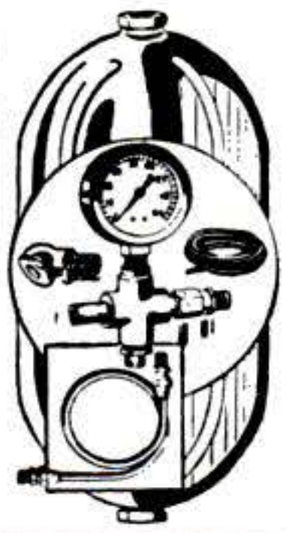

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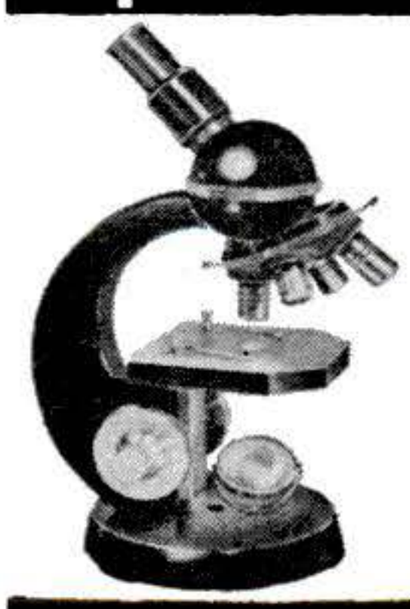

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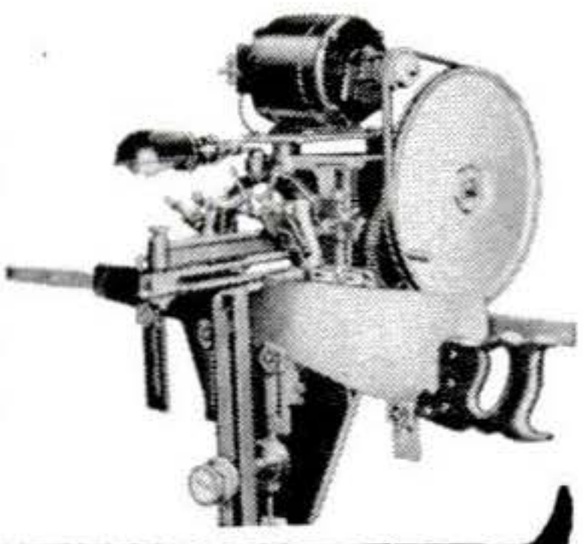

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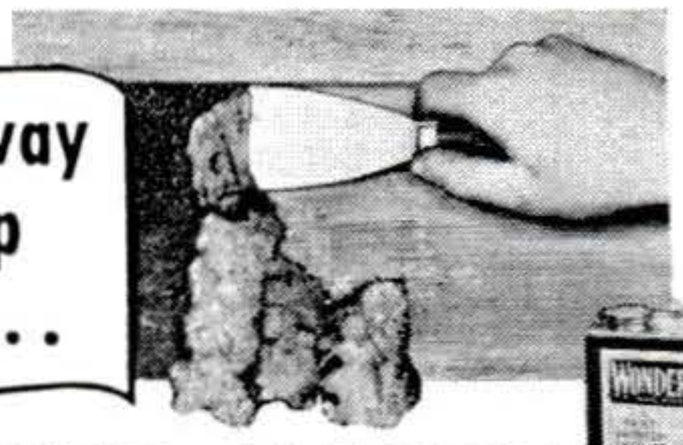

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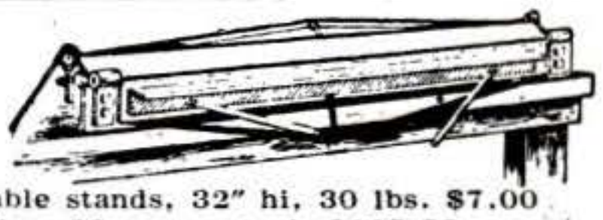


Angles, flanges, Pittsburgh locks. 24 G. steel, heavier aluminum. Cam locking, mount on bench, truck or floor stand. Truss braced steel. Express collect, 30", 65 lbs. $28.50. 36", 75 lbs. $33.00, 48", 100 lbs. $48.00. Portable stands, 32" hi, 30 lbs. $7.00

IRON BENDER

8 ft. BRAKE, similar, 26 gauge steel, **$115.00**
IRON BENDER forms hooks, angles, eyelets, etc. Capacity ¼x2", 5/16x1½", 10 parts, all steel. Express Collect..... **$9.50**
12" PRESS BRAKE. Fits any drill press. Open ends, forms compound bends.....**post paid** **$9.50**

(Immediate delivery. Order direct, cash or C.O.D., or send for folder.)

VYKE BRAKE CO., S-3016 Leavenworth, Omaha 5, Nebr.

BUILD YOUR OWN

ARC·WELDER FROM AIRCRAFT GENERATOR

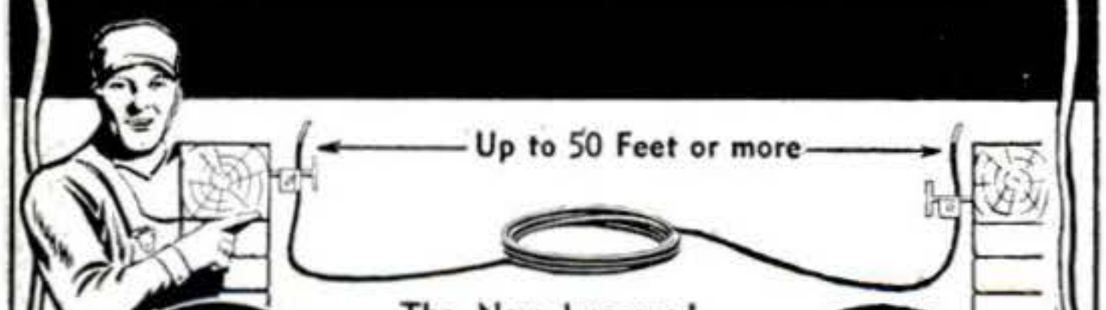
For Light or Heavy Work

We show you how to build this NEW powerful welder without rewinding. Uses most any surplus aircraft generator. Produces 75-300 amps. Easy to build. Complete PLANS 35c. Send today & we'll include FREE our Big War Surplus and Electrical Catalog.

LEJAY MFG. CO.,
1223 LeJay Bldg.,
Minneapolis 8, Minn.

LEVELALL

FASTER THAN $100 ENGINEER INSTRUMENTS



Regular 50 Feet **$8.95**

The New Improved Water Level For Simplest One Man Operation

Anything you need level Levelall does it.
Dealer inquiries Invited

DeLuxe 75 Feet **$12.95**

A sturdy instrument that can be left on the job for any workman to use. Cannot be put out of adjustment and even with the most casual handling its principle is so simple anyone can level points quickly and accurately.

For footings, forms, batter boards, sills, lintels, floors, ceilings, roads, driveways, lawns, piping, farm contouring and all general construction work normally needing an expensive instrument.

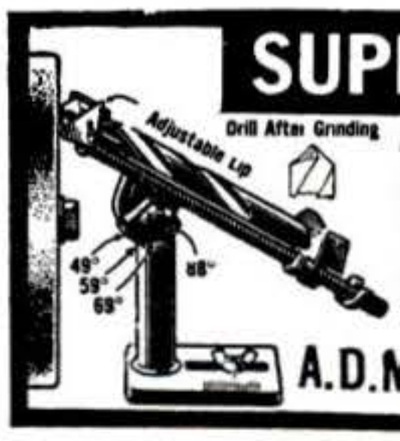
1 qt. extra Level-Flo Liquid shipped with Deluxe Model only.

Complete with instructions, high quality vinal polechloride tubing filled with Level-Flo Liquid, mounting brackets, and metal case.

LEVELALL, 81G Webster St., Rockland, Mass.
Mail me ..... 75' DeLuxe Levelall @ $12.95
Mail me ..... 50' Levelall Instruments @ $ 8.95
you guarantee satisfaction or money back upon return of Levelall within ten days.

Name .....
Address .....
City ..... Zone ..... State .....
☐ Send C.O.D. I will pay postman full purchase price plus delivery charge on arrival.
☐ Full purchase price is enclosed. Send postpaid. (Postage prepaid on orders in U.S.A. only).

SUPER DRILL GRINDER



Sharpens round shank drills from 3/32" to ½" in diameter, up to 6" long. Grinds old drills like new in 4 different point angles, using hand or power grinding wheels. Money-back guarantee, only **$2.95**

At Dealers or Postpaid

A.D.McBURNEY 317 E. 4th St., Dept. S-30 Los Angeles 13, California

FREE CATALOG OF GOVERNMENT SURPLUS

ALL PURPOSE KIT 1.98 PP & HAND .35

GRIND • POLISH • BUFF • SAND
Fits All Electric Drills—Kit Contains 5" Polishing Bonnet, Seven 5" Sanding Discs, Rubber Backing Pad, 3-Pc. Arbor AND the Following All on Individual ¼" Shanks: Wire Brush, Felt Bob, Grinding Wheel, Sanding Cartridge. Regularly $5.00.

WRAPLOCK 1001 USES **2.49** PP & HAND .50

The Most Efficient All Purpose Clamp Ever Made — Will Conform to Any Shape and Tie Anything That Can Be Tied with a Clamp. Complete with Strapping, Buckles, Cotter Pins, Keys, Ratchet Wrench — Gov't Surplus.

12 BIG STEEL CUTTERS 3.60 POSTPAID

In Plastic Stand with Cover Standard 3/32" Shanks. Reg.$6.00

Dental Specialty & Sales Co., Dept. PS9 P.O. Box 692, Great Neck, N.Y.

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Palley's

SAVE UP TO 85% IN WAR SURPLUS

ORDER BY MAIL!

SWIMMING EQUIPMENT

SWIM FINS

Made of top quality rubber with pebble tread bottoms. Reinforced, adjustable heel strap. Vented for air & drainage. Ideal for diving & swimming. Available in men's, women's and childrens sizes. 5.95

DIVING MASK

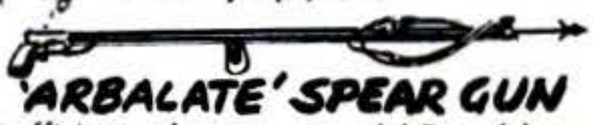
A fine quality mask. Ideal for shallow water skin diving or swimming. Soft gum rubber with sturdy glass lens and adjustable head band. Lightweight & water-tight. Comes in 3 sizes.

JR. 4½" 2.59 MISS 5" 2.69 MR 5½ 3.95

We carry a complete line of Swimming, Diving and Fishing equipment. Write us your requirements.

NEW SELF CONTAINED DIVING UNIT

Enjoy easy breathing and freedom of movement under water. This unit has a self-operated, rust-proof, regulator & outlet valve. The 480 cu. in. compressed air cylinder allows up to 1/2 hour under water. Has perfected mouthpiece 2 flex hoses to regulator & free-movement harness. Standard U. S. Navy equipment. 115.00



'ARBALATE' SPEAR GUN

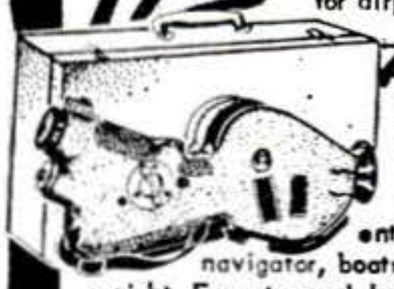
Most efficient underwater gun made! Powerful, accurate, silent. Uses "crossbow" principle. Rubber powered. Has safety catch & will float after spear is released. Can be reloaded under water. Normal range is 14 feet. 24.95

SNORKLE BREATHING TUBES – Plastic with rubber mouthpiece. Allows breathing with face under water. 1.95

CURVED TYPE – Has automatic seal when immersed. 2.95

NEW ARMY D-12 MAGNETIC COMPASS

A real WAR SURPLUS BARGAIN! Was standard navigational equipment on all Army Aircraft. Has a rotating verge range ring, calibrated in 1 degree increments from 0 to 360°. Two parallel grid wires for N-S alignment. Ideal for airplane, boat, etc. 17.50



A.F. SEXTANT

Designed and made to the high standards of the Armed Forces. Ideal for use in all navigation work. An excellent instrument for the student navigator, boatman, private pilot, etc. Lightweight. Easy to read, bubble level type. Can be used to "shoot" Sun, Moon or Stars. Comes in handy carrying case. A Palley Special at 12.95

FAMOUS PALLEY MIXES

WAR SURPLUS MIX. Four hand tools plus an Army Scoop for fireplace or barbcue. Tools alone are worth far more than our price but we throw in the Scoop FREE! include a Hammer Punch, Chisel-Hammer, Stake Driver and 17" Stanley Screwdriver. All have crucible cast steel heads and hardwood handles. For home, farm, ranch, machine shop, garage, etc. 2.89

AERO SEAL HOSE CLAMP MIX

Another Palley Bargain Mix. 24 assorted hose clamps of various sizes & types. Ideal for use on autos, trucks, tractors, boats, planes, pumps, etc. All are finest, aircraft quality. Be Prepared. 2.95

FILE MIX – 10 assorted Files. 4 inch to 12 inch. This includes Vixens, Half Rounds, Mills, Bastards, etc. In seconds and used but good condition. One Vixen alone is worth our price for entire mix. 99¢

GADGET MIX – Another SURPLUS BARGAIN! Includes Rivets, Spacers, Bolts, Screws, Wheel Bearings, Springs and Clamps. 5 pounds for ONLY 1.19

TERMS

ORDER FROM THIS AD.. Pay by M.O. or Check. P.O's accepted from well rated D & B firms. 50% deposit required with all C.O.D's. All prices are F.O.B. our warehouse, Los Angeles, Calif.

KAPOK FILLED MUMMY BAG

Another BARGAIN from Palleys! Filled with 2½ pounds of 100% KAPOK. Has water-repellent, Balloon cloth cover and lining. Easy to pack... Weighs only 4½ lbs. Cut size is 36" by 90". Has 3/4 length zipper closure. You'll want one of these! 9.95

SPECIAL SLEEPING BAG

Covered in special, new plastic Miracle Cloth which sheds water and repels dust. Lined with glossy, quilted sateen. Filled with 3 lbs. of 100% WOOL. Has double pull zipper down side and across bottom to form one double-up bag when two are zipped together. Has two air mattress pockets. Large headflap has two built-in pockets. Finished size is 34" x 78". Weighs 7-1/2 pounds. 21.50

AIR MATTRESS

Made of heavy Vinylite plastic. Ideal for sleeping bags, cots or as a swimming float. Inflated size: 25" x 72". A $7.00 value ONLY 5.95

BRITISH ARMY PACK RACK

The famous Everest Pack Carrier. Has an all steel frame with a canvas covered, fold-up bottom pack shelf. All straps are genuine leather. Designed so there is a minimum of rubbing and weight is evenly distributed. Strap across lower section acts to absorb shock and sway. Folds flat when not in use. Weight only 3-1/2 pounds 7.95

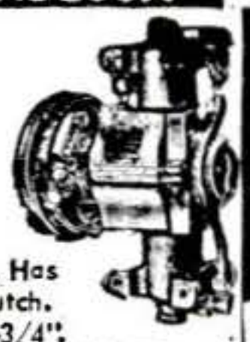
Air Corps RUBBER BOATS

Made to Gov't specifications. Ideal for use in lakes, rivers, or ocean. Just the boat for the fisherman or hunter. Safe, lightweight, easy to pack. Reconditioned and ready to use.

1 MAN 18.95 7 MAN 49.95

PADDLES 59¢ EA. AIR PUMP 3.95

WESTINGHOUSE COMPRESSOR



A 2 cylinder, piston type Air Compressor. Ideal for spraying, inflating, air tools. Used in garages, shops, laboratories – on trucks, tractors, jeeps, etc. Will run off fan belt or power take-off. Operates on 1/2 HP, Gas or Electric motor. Runs in either direction. Delivers approx. 3.27 CFM at 600 RPM or 6.54 CFM at 1200 RPM. Has 2" bore, 1-1/2" stroke. Automatic clutch. Size: Width 9", height 11-7/8", depth 5-3/4". Approx. weight 23 lbs. We have motors, tanks and fittings to adapt this unit. ONLY 23.95

230 PAGE CATALOG

1000's of ITEMS! Fully ILLUSTRATED! For the MECHANIC, SPORTSMAN, HOBBYIST, HOME OWNER, etc.

War Surplus – Factory Closeouts and General Merchandise Values! Save on Hardware, Hand and Power Tools, Gadgets, Sports Equipment, Hydraulics etc. SEND 25¢ for HANDLING & MAILING.

FIRE EXTINGUISHER

(DECONTAMINATING M2)

You'll want this all-purpose, hand pump, spraying unit. Use it as a Fire Extinguisher, an insect spray, garden & hothouse spray, decontamination, special irrigation, feeding plants, etc. Will shoot a forceful stream approx 25 feet or spray a soft, dewey mist. All metal construction with handy rack. Easily filled & operated. Another Amazing Palley Bargain! 3.95

NAVY PHONE SET

Used by the NAVY for Flight Deck and Gun Control. An ideal emergency communication system because each set is "sound" powered – no other power supply needed. Perfect for office-to-shop, house-to-garage or barn or any point-to-point within the radius of 1/2 mile. Each set includes two phones on chest-plates, two headsets, button switches and approximately 35 feet of wire. A Tremendous Buy 9.95 SET

One Phone and Headset . . . 5.95

2-WAY PHONES

Install this set of desk phones for perfect two-way communication from any two points up to 100 feet apart. This handsome set is finished in blue, baked enamel. Has two phones, wire and simple hook-up instructions. Operates on ordinary flashlight batteries. Here is an ideal set for use room-to-room, house-to-garage or barn, darkroom-to-outside, office-to-office or shop, etc. A Time & Step 7.50

RADIO BARGAINS

Popular Telephone Type. Highly sensitive. Has excellent, clear tone. Was the Signal Corps favorite. An ideal Instrument for the Radio "Ham" and the professional recording studio, for broadcasting, home recording, public address systems, etc. Unit comes complete with cord & plug. 3.29

USAF THROAT MICROPHONE

Genuine USAF type T-30-0. Gives clear, distinct voice reproduction for aircraft or the amateur broadcaster. Set consists of two microphones, mounted on rubber neckpiece which is fastened to elastic neck band. Operates between 100 and 300 ohms. 1.39

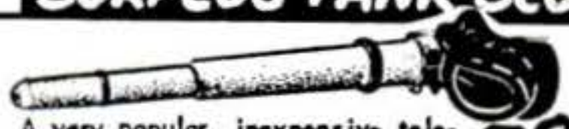
NEW RADIO SPEAKERS

Ideal for small radios, inter-com systems, test equipment, etc.

ALNICO – Permanent magnet type. 4" diam. 2 wire hook-up. NEW 2.49

DYNAMIC SPEAKER – 10" with plug-in and transformer. A popular model for use in radio sets, TV receivers and portable Public Address systems. Has full tone range. Standard rim mounting. A Bargain. 2.95

SURPLUS TANK SCOPE



A very popular, inexpensive telescope. Easily sighted with formed face piece. All brass construction. FULL 20 POWER magnification. 8.95

MARK VII DRIFT SIGHT

Originally designed for aerial navigation. Can be used as single power telescope. Contains many valuable prisms, lenses, etc. Recording mount has spring wound motor, needle bearings, worm gear, ring gear, stylus, rheostat & other items of value. Here is a precision instrument of interest to the inventor, experimentor, scientist, student, gadgeteer & hobbyist. The optical parts alone are worth more than our special Bargain Price. . 14.95

PALLEY SUPPLY CO. Dept. PS-6, 2263 E. Vernon Ave., Los Angeles 58, California

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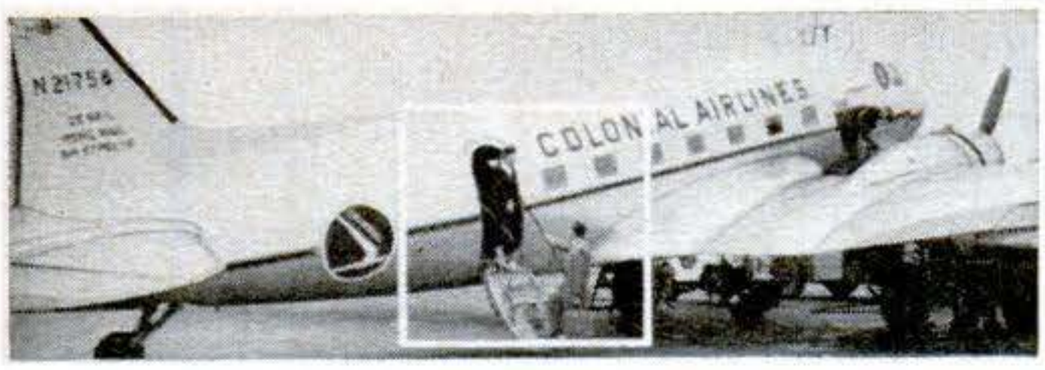
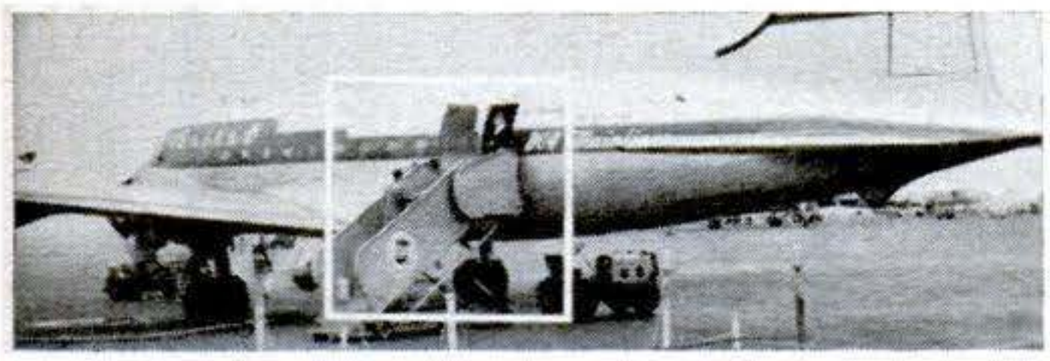
Answers to "What Airliner Are You Boarding?" Quiz on Page 104.



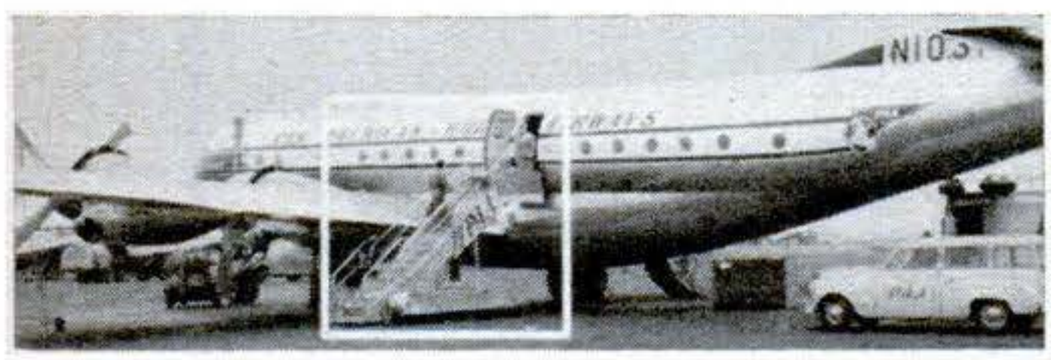
1. Douglas DC-3

2. Lockheed Super Constellation

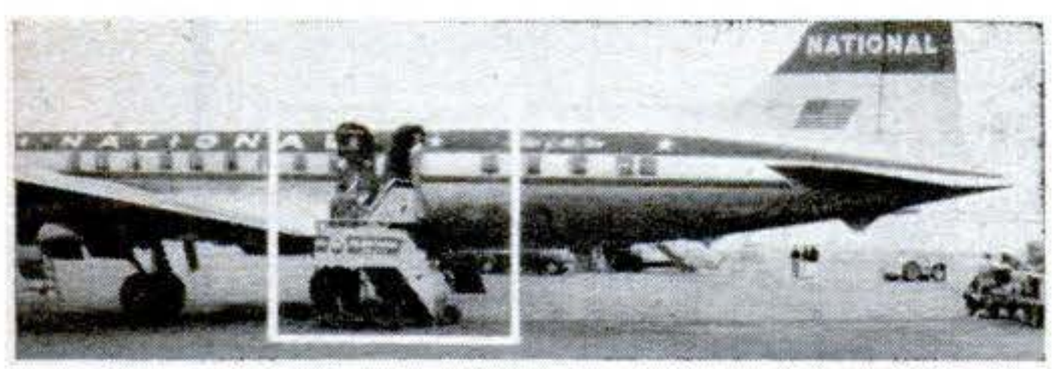
3. Convair-Liner



4. Douglas DC-4



5. Boeing Stratocruiser



6. Douglas DC-6

7. Martin 4-0-4

This Little Car Has Big Ideas

[*Continued from page 92*]

makes its contribution. Each wheel is insensitive to the movement of other wheels. Adding to a smooth ride is the fact that the front suspension arms face forward and the rear suspension arms face rearward, with their pivoting points close to the center of the frame. Thus, since upward thrust of both front and back wheels as they hit a bump is near the center, there is no bucking—the car remains level. And there are no axles in the true sense. The individual drive axles to each wheel carry no weight, only torque to the wheels.

Combined with this suspension is a spring system that takes only the dead weight of the vehicle—and has a full eight inches of vertical travel before hitting bottom. The springs do not have to absorb twisting, side shock and torsion as in ordinary cars.

New Seat Smooths Ride

Then there is the No-spin differential. This is a complex gearing arrangement that gives traction where it is needed. If a wheel loses traction, it doesn't spin faster, using power to no purpose. Even if three wheels lose traction, all engine power is transmitted to the fourth wheel.

As for the smooth ride, a lot of credit for that goes to a new type of seat called Flotation Motion. The bottom and back are all one spring—they give as one unit, with the back taking up 30 percent of the body weight.

Another feature, now being tested by the Marines, is a flotation kit. This consists of a rubber bladder that fits around the vehicle and is inflated from the exhaust. Lightweight paddles are attached to the rear wheels. And the Mighty Mite is a motorboat. **END**

Change for the Better

Farmer: "Well, Maggie, now that we've struck oil I want you to have some decent clothes." Maggie: "Nothin' doin'. I've worn decent clothes all my life—I'm gonna dress like other women now."—*Wireco Life.*

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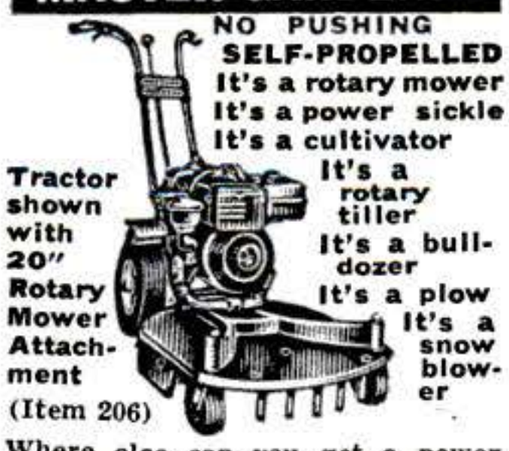
SAVE MIDDLEMAN PROFITS

MASTER GARDENER



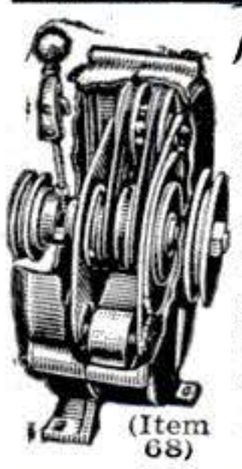
(Item 206)

Where else can you get a power tool that does so many jobs? Works for you year 'round. Does terrific job cutting grass or weeds. Or, prepares mellowed deep seed bed without labor. Built-in power take-off to drive pumps, saws, generators, etc. Safety clutch—can't burn out. More versatile and efficient than tractors costing twice as much. Converts in minutes to Tiller, Power Sickle, etc. Basic self-propelled 2 hp tractor with Briggs or Clinton famous engine. Only..... **$119.50**
Rotary Lawn Mower.....$42.50
Sickle Bar Mower.....$42.50
Lawn Mower Hitch.....$ 4.50
Cultivator .....$ 8.75
Rotary Tiller.....$42.50
Furrowing Tool .....$ 8.75
Disc Harrow $15.75
Plow .....$ 8.75
Snow Blow $39.50
Freight prepaid to most areas. Easy payment plan available.

NEW MOTOR BIKE

Our Commando Motor Bike is trouble-free—carries amazing 5 yr. guarantee. Goes to 150 miles per gal. on all roads. Speed to 40 mph. No oil or gas fumes. Easy automatic pedal or pull starting. Has new principle of automatic transmission. No belts or chains—power transmitted directly to rear wheel. Accelerates quickly. Complete motor and kit ready to attach to your bike in 1 hour. Get free folder. Factory Price. **$125.00**
Complete Motor and Chassis..... **$199.50**

Variable Speed Selector


(Item 68)

Heavy duty, made by **B. F. GOODRICH** for industrial use. Provides instant speed changes for any drive. For machine tools, dryers, printing, conveyors, production lines, hoists — any operation requiring variable speed. Ideal for midget autos. Employs reliable "trouble free" planetary system. No hydraulic power losses or creeping. Infinite range, smooth operation, easy installation (data included). 3 sizes: ½-1 hp. wt. 36 lbs.; 1-2 hp. wt. 55 lbs.; 2-3 hp. wt. 105 lbs. Reg. list $228, $252 and $352. Our prices . . . **$79.50, $89.50** and **$114.50.**

3-Pc. ADJUSTABLE WRENCH SET

Made of finest steel alloy, chrome plated. Prices are exactly half actual value. Takes the place of a whole set of tools. Packed in leatherette pouch.
Set A—4-inch, 6-inch, and 8-inch wrenches, (Item 107), wt. 2 lbs., only **$2.95**
Set B—8-inch, 10-inch, and 12-inch wrenches, (Item 108), wt. 4 lbs., only..**$6.45**

3-Pc. PIPE WRENCH SET

Made of finest German Tool Steel. Completely drop forged. Pipe sizes clearly marked for easy one-hand setting. Heavy sharp jaws will never slip. Ideal for master craftsmen. Set includes 8"—10" and 14" wrenches. Covers most pipe sizes. A combination of brute strength and precision workmanship. Will pay for themselves on one job. Item 12. Wt. 6 lbs. Easily worth $11.95. While they last..... **$6.55**

WORLD'S FINEST GUARANTEED LIGHT PLANTS

PORTABLE LIGHT PLANTS

(Item 24)

PUSH BUTTON START A.C. PLANT 500-700 watts—115 v. —60 cyc. A.C. Powered by a rugged 2 hp. easy-starting Briggs gas engine. No wiring necessary, just plug in and operate. Plenty of current for any oil burner, freezer, brooder, emergency lights, etc. which require up to 700 watts. Ideal for Civil Defense, Fire Depts., trailers and camps. Complete with Voltmeter and built-in winding to charge 6 v. auto batteries. Item 24. Wt. 85 lbs. *Be prepared if war or storm knocks out power lines.*
Reg. $275 value..... **$143.50**
700-800 Watt Plant (Item 44)
same as Item 24 but larger engine..... **$169.95**
1000-1200 Watt Plant (Item 45)
same as Item 24 but larger generator & engine.. **$199.50**

1500-1700 Watt Plant (Item 20)—Similar to Item 24, but has three times more capacity. Wt. 173 lbs. Factory price..... **$279.50**

350 Watt Plant (Item 273) 115 v. D.C. 1½ hp. Briggs Engine. Perfect for lights, radios, small power tools. Wt. 65 lbs. Factory price... **$99.75**

MASTER-LITE 2500 Watt PLANT (Item 21)

(Item 21)

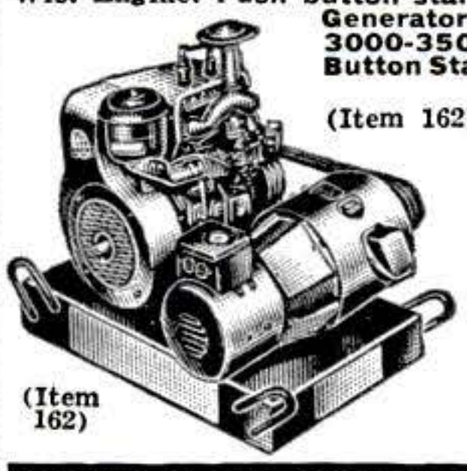
110/120 v. 60 cyc. AC. A powerful plant, ruggedly constructed and yet designed for easy portability. Can be started by rope or built-in 12 v. electric push button starter. Built in winding to charge battery. Powered by a big 5.10 HP Briggs engine, complete with all accessories. Includes control box, voltmeter and handy plug-in power receptacle. An ideal plant for permanent or stand-by service. wt. 225 lb. Regular price $645.00. Factory price..... **$329.50**

GIANT 2000-2500 Watt Plant

110/120 v. AC, belt driven so that engine may easily be utilized for other purposes. Powered by a rope start, 6 HP engine wt. 230 lbs. Regular list $585.00. Factory price.....(Item 31) **$299.50**
Generator only and control box..(Item 31a) **$169.50**

3000-3500 WATT PLANT (Item 198) **110-220** v. 60 cyc. A.C. Belt drive with Wis. Engine. **Push button start.** Wt. 370 lbs. Heavy duty.....**$399.50**
Generator only for belt drive, Wt. 115 lbs. (Item 198A) **$239.50**
3000-3500 Watt Plant (Item 23) 115 v. 60 cyc. A.C. **Push Button Start.** Direct Drive. Wt. 270 lbs. Factory Price **$379.50**

HI-LINE 6000 WATT PLANT

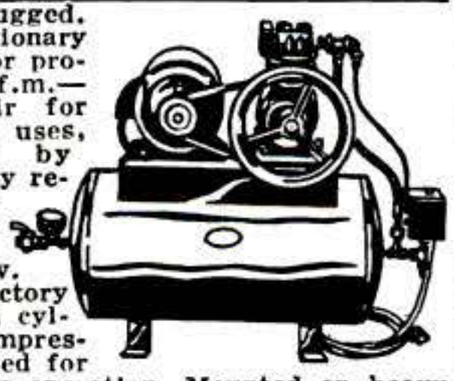

(Item 162)
(Item 162)

Push Button Start, 115-230 v. 60 cycle A.C. A brute of a power plant with a rugged 13 hp. Wisconsin engine. Plenty of electricity for ranges, water heaters, freezers, pumps, machinery, etc. Affords both 110 and 220 volts. Ideal where heavy current is needed. Wt. 590 lbs. Easily worth $995.00. **With self starter.** Factory price..... **$645.00**
Same plant but **with Crank Start.** (Item 166)..... **$585.00**
Generator and control box only, belt driven. Use your own engine or tractor. Wt. 240 lbs. (Item 163) Factory price..... **$345.00**
We make fully automatic controls to operate any of above light plants. Write for details.

MASTER AIR COMPRESSOR

(Item 209) High pressure type for large volume of air for heavy duty service. For paint spraying, inflating truck and auto tires, greasing, and the hundreds of other jobs done by compressed air. Piston type, 2" bore compressor with built-in air filter. Master built with hi-strength alloys and precision bearings. Stainless steel tank, 12"x24", 2100 cu. in. cap. Safe up to 500 lbs. Equipped with automatic switch that starts and stops motor to maintain desired pressure (up to 150 lbs.) and check valve, safety valve, gauge, shut-off valve, 20 ft. air hose and tire chuck. Beautifully balanced on ball bearing wheels and rubber tires. Low factory prices. With ⅓ hp. 110 v. A.C. motor (Reg. $175.00) (Item 209)..... **$98.50**
With ½ hp. motor. Reg. $199.50. (Item 209A)..... **$119.50**
With 2 hp. Briggs Gas Engine. (Reg. $199.50) (Item 209B)..... **$109.50**
Write for prices of compressors only. A complete line of spray guns and air tanks available.

MASTER SHOP COMPRESSOR



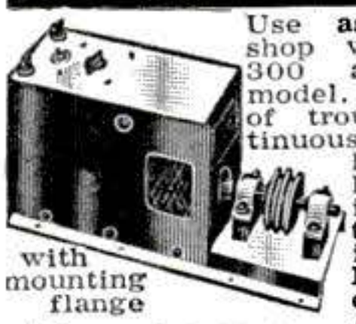
Big and rugged. This stationary compressor provides 8 c.f.m.—plenty air for industrial uses, powered by heavy duty repulsion induction ¾ HP 115/230 v. motor. Factory type twin cylinder compressor designed for continuous operation. Mounted on heavy 20 gal. steel tank. Complete with unloader type automatic switch, pressure relief valve, check valve, gauge, shut-off valve, and 20 ft. heavy duty air hose. (Item 209h) Regular retail $319.50. factory price.. **$189.50**

DIESEL LIGHT PLANT

(Item 1660) **Diesel Master**—11-12 kw. 115/230 V. A.C. single or 3 phase. 1800 rpm. direct connected. Designed and engineered for permanent power installations. Assures efficient, dependable low cost operation where heavy current is important. Wt. 1350 lbs. Regular list $3,650.00. Factory price **$1895.00**

10-11 kw. GAS DRIVEN PLANT. 115-230 V. 60 cycle A.C. powered by 4 cylinder Wisconsin air cooled engine. Belt driven. With self starter. Constructed similarly to Item 162 but much larger. Item 217 wt. 900 lbs. Factory price.. **$1245.00**

HEAVY DUTY D-C ARC WELDER


with mounting flange

Use as portable or shop welder. Up to 300 amps. Senior model. Made for years of trouble-free, continuous service. Will handle light or heavy jobs. Easily welds up to ¾" plate using ¼" rods. Built-in air cooling system. Arc is easy to strike and hold, because of specially designed arc stabilizer. Hi-lo switch and dial control gives wide range of welding heats. Run welder at 2600 rpm. with tractor, jeep or 15 hp. gas engine, or 7 hp. elec. motor. Complete with instructions, guar. and double V belt or flat pulley. You can pay more, but you can't buy a better welder. (Item 38) Wt. 110 lbs. $400 value at..... **$99.75**
DUAL CONTROL MODEL same as above but with built-in dual rheostat for low heat soldering, brazing, welding. Spec.. **$119.50**
WELDING KIT. Two 10 ft. leads, welding helmet, electrode holder, ground clamp. Sold only with welder at..... **$10.50**
Write for prices on A.C. Arc Welders.

Factory Prices on Catalog Items

Send 10¢ for **BIG 1953** catalog. **Hundreds of bargains**

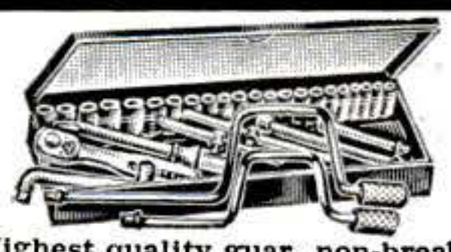
EXTENSION CORD

Heavy duty made of Buna insulated #14, 2 conductor stranded wire encased in a treated braid jacket moderately flexible and ideal where frequent coiling is not required. Resists oil, grease or water. Use indoors or out. Complete with heavy rubber plug and outlet. (Item 16) 40 ft. 2½ lbs. **$1.99**
Comb. 2-40 ft. and 1-20 ft. (total 100 ft.).....**$4.95**
100 ft. length (1 piece)....**$4.85**

NEOPRENE EXTENSION CORD

#16, 2 conductor stranded wire, extremely flexible, ideal for hedge trimmers, lawn mowers, power tools, etc. Tough and rugged, withstands any abuse. Complete with rubber plug and outlet. 40 ft. (Item 16a) wt. 2½ lbs. regularly $4.95, SPECIAL.... **$2.49**
100 ft. length (1 pc.).....**$5.85**
Wire only. No fittings....**$5.00**
NEOPRENE CABLE #14-2 (Item 185) Heavy duty, very flexible, 20 year quality.
Wgt. 9 lbs. 100 ft.....**$8.95**
NO. 12-2 POWER CABLE. Very flexible rubber covered, special outside shield for grounding power tools, etc. 50 ft. (Item 199) wgt. 8 lbs.....**$6.96**
100 ft. (Item 200).....**$12.95**

32 Pc. SOCKET SET



Highest quality guar. non-breakable sockets made by Husky. Beautiful, matched chrome alloy, absolutely the best. Complete range of 21 sockets from ¼"thru 7/16" in ¼" drive and 7/16" thru 1-1/16" in ½" drive; 2 extensions, reversible ½" ratchet, adaptor bit, slide head, all angle coupling, 2 end wrenches, ½" speeder handle and sturdy metal tool box. For prof. mechanics who want the best. Wt. 14 lbs. (Item 59) Easily worth $41.50 ..... **$16.95**

37 Pc. SOCKET SET

Consists of above described set, but includes a **big** doghouse tool box with ample room for other tools **plus** a 5 pc. hi-chrome alloy combination wrench set. Easily worth $49.50. (Item 59b)..... **$19.95**

45 Pc. SOCKET SET

(Item 205) Contains a complete set of sockets in ½" drive, ⅜" drive and ¼" drive, plus all necessary extensions, handles, speeders, reversible ratchets, etc.; all uncond. guaranteed against breakage. Beautiful matched chromed thin wall alloy sockets in a sturdy handsome steel tool box. Wt. 17 lbs. List price $62.90. Factory Special.....**$26.95**

VENTILATING FAN

(Item 10) Mount in wall or ceiling to ventilate any area. Over range, removes kitchen smoke and odors. Easily installed in furnace pipes. Forces even heat to all rooms. Powerful continuous duty motor, 110-120 v. A.C. Quiet, super efficient fan moves huge volume of air (400 to 600 c.f.m.) 8" Fan, wt. 5 lbs., **$6.85;** 9" Fan, wt. 6 lbs., **$7.85;** 10" Fan, wt. 7 lbs., **$8.85;** 12" Fan, wt. 8 lbs., **$9.85.**
HEAVY DUTY FAN. Semi-enclosed motor, suitable for spray booths, restaurant exhausts, poultry houses, etc. 10" Fan, wt. 8 lbs. Item 10E **$11.95.** 12" Fan, wt. 10 lbs. Item 10D **$12.95**

HYDRAULIC JACKS

Heavy duty, precision built, smooth, positive acting with built-in relief valve. Hi-Lift with screw extensions. Govt. surplus at a fraction of orig. cost. (Handle included.) 3 ton (Item 208A) Wt. 15 lbs.... **$9.45**
5 ton (Item 208B) Wt. 17 lbs..... **$11.45**

Prices f.o.b. Factory. 10 day Money back guarantee. Send check or Money Order
MASTER MECHANIC MFG. CO., DEPT. 61-C Burlington, Wis.

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It's no trick at all to make extra money day after day when you can offer car owners America's greatest seat cover values . . . and a choice of patterns, styles and materials that will fit their car such as no one else in your territory could possibly offer! Free Sample Outfit that fits into your pocket . . . complete with swatches of the gorgeous new materials . . . will start you taking orders at once. No one can compete with you in wide choice, in quality —and in expert tailoring that makes covers fit like a pair of gloves. And when you quote the low direct prices that are only a fraction of what the customer expects to pay you'll find you can make money hand over fist writing up the fast orders! Line includes nationally advertised sensations like BLACK EBONY Saran, in the new Black and Silver Watermelon Stripe, beautiful beyond description BAMBOO, luxurious, brilliant FIESTA, colorful BULLFIGHTER PLAIDS, plus many other exclusive patterns to choose from, all at unbelievably low prices. It's no trick at all to make big money, whether you sell full time or just in spare time. OPPORTUNITY TO SELL AT WHOLESALE TO GARAGES, SERVICE STATIONS, ETC.

$45.00 SET OF COVERS

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How Any Car Owner May

Often Much More - With the Au

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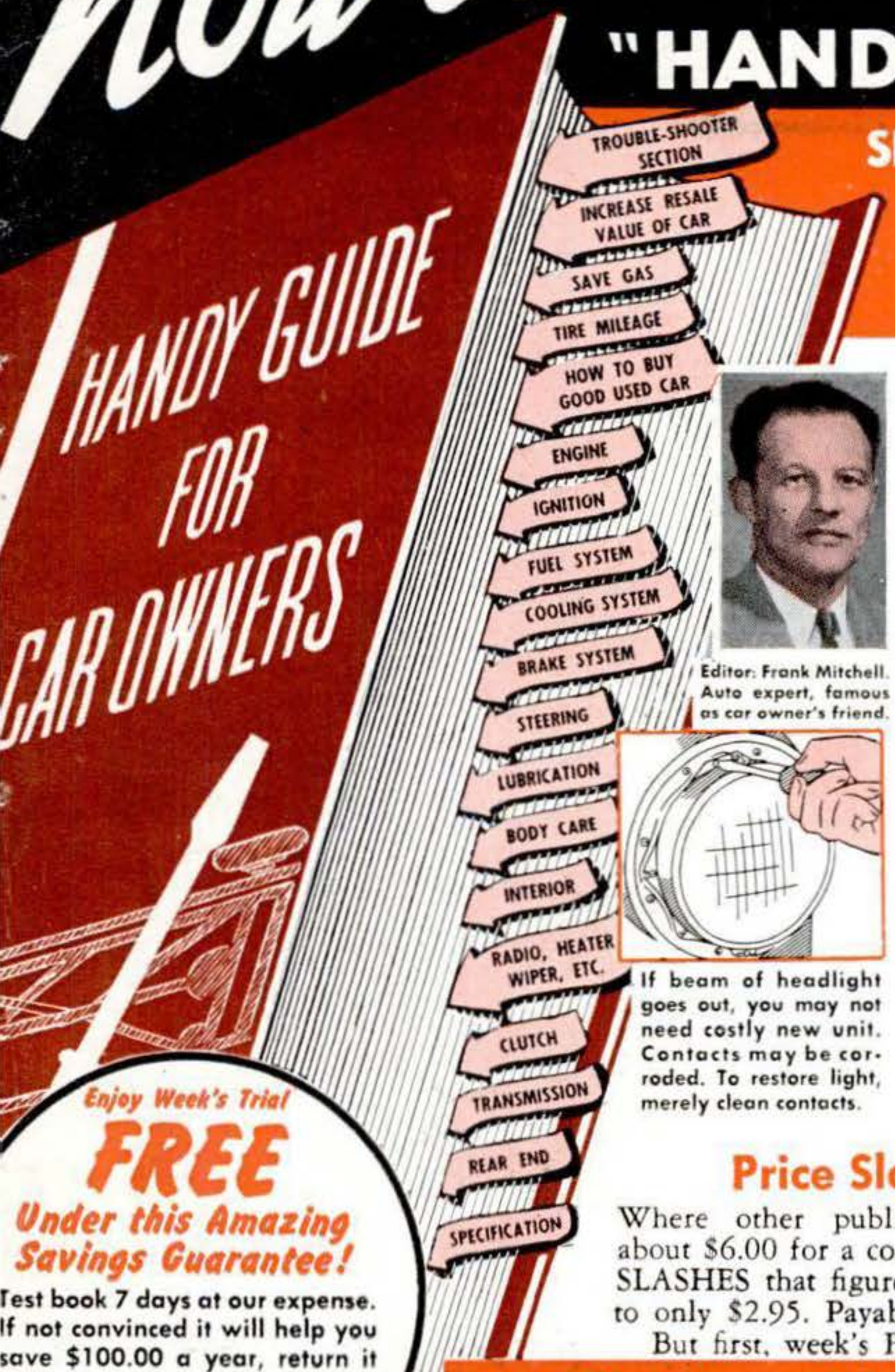

Editor: Frank Mitchell. Auto expert, famous as car owner's friend.

If beam of headlight goes out, you may not need costly new unit. Contacts may be corroded. To restore light, merely clean contacts.

Shows Average Car Owner 101 Ways to
On Gas—Oil—Tires—Insurance—Rep
Beautifying—Buying—Selling—Tradin
No Magic Miracles! Just Plain Com

HERE IT IS! The *first* book ever published with th telling everything the average car owner needs to k — to keep his car purring like a kitten.

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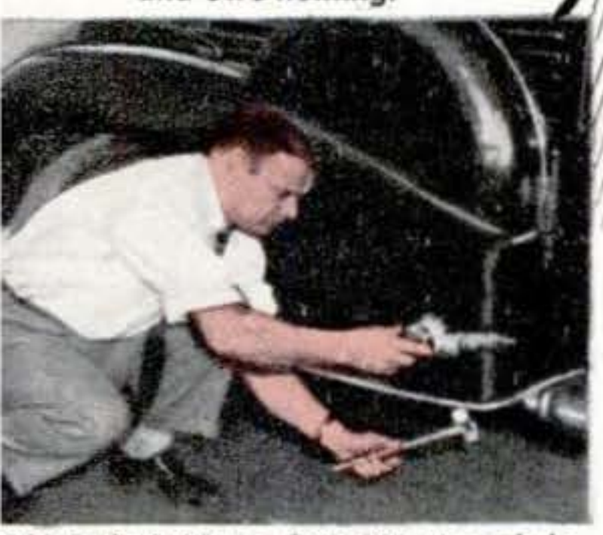

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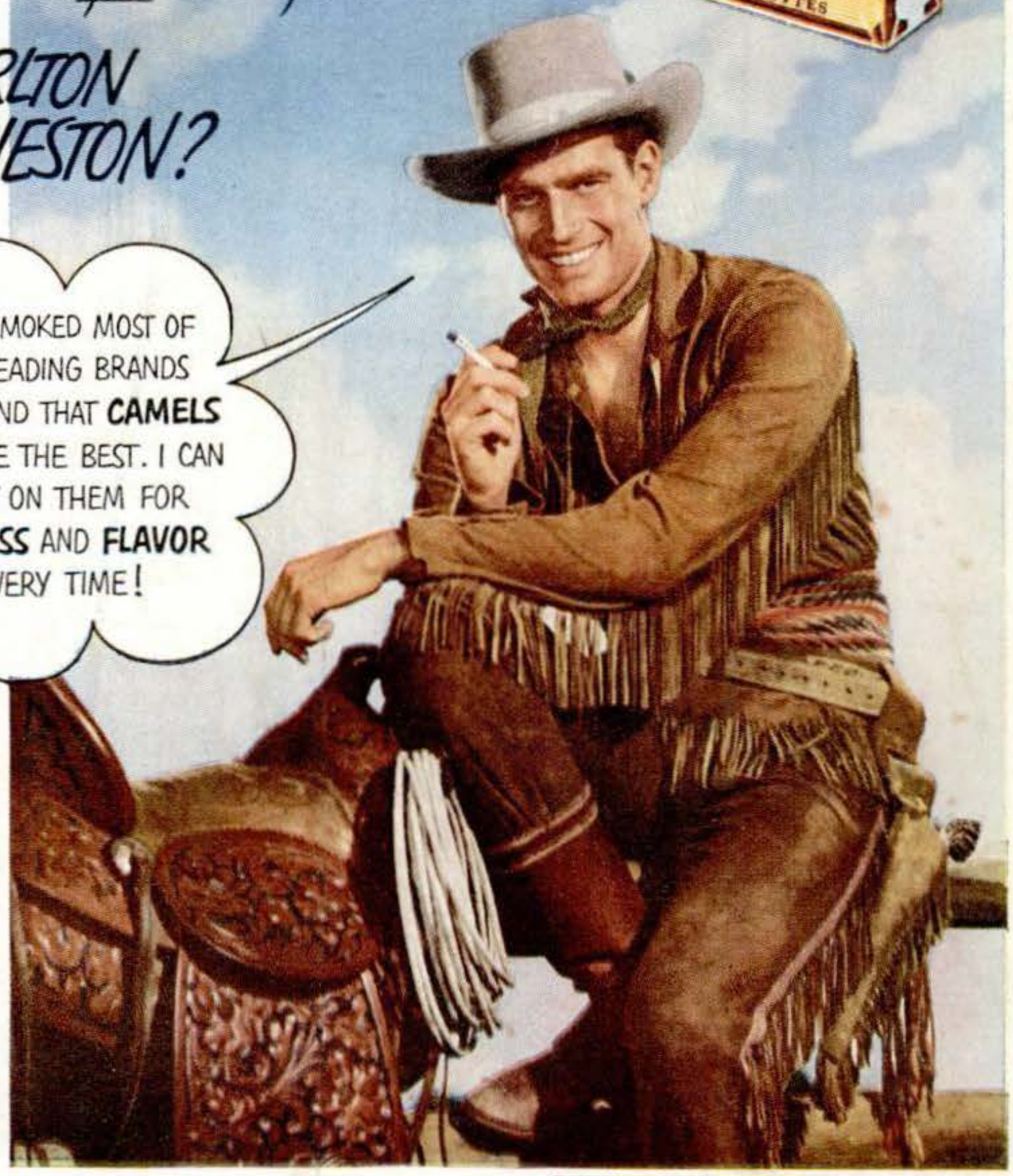

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